

## DOCUMENT RESUME

ED 193 539

CE 027 134

**TITLE** Military Curriculum Materials for Vocational and Technical Education. Miniature/Microminiature Electronics Repair. CNET W-100-0034B. Classroom Course 7-15.

**INSTITUTION** Fleet Training Center, Norfolk, Va.: Ohio State Univ., Columbus. National Center for Research in Vocational Education.

**SPONS AGENCY** Chief of Naval Education and Training Support, Pensacola, Fla.

**PUB DATE** May 79

**NOTE** 1,624p.

**EDRS PRICE** MF13/PC65 Plus Postage.

**DESCRIPTORS** Behavioral Objectives; Curriculum Guides; Electrical Occupations; \*Electric Circuits; \*Electronic Equipment; \*Electronics; \*Equipment Maintenance; High Schools; Learning Activities; Lesson Plans; Postsecondary Education; \*Repair; Secondary Education; Trade and Industrial Education

**IDENTIFIERS** \*Microminiature Circuits; Military Curriculum Project; \*Miniature Circuits; Solderers

## ABSTRACT

These instructor materials (curriculum outline, lesson plans) and student guide for a high school-postsecondary level course in miniature/microminiature electronic repair are one of a number of military-developed curriculum packages selected for adaptation to vocational instruction and curriculum development in a civilian setting. The course consists of four units containing fifteen lessons covering 118 hours of instruction: (1) Introduction to the School and Course (Introduction to the Course, Introduction to High Reliability Soldering, Preventive Maintenance of the 2M Repair Station), (2) Printed Circuit Board Repair (Conformal Coating Removal, Desoldering Printed Circuit Board Components, Printed Circuit Board Component Installation and Soldering, Repair of Damaged Printed Circuit Boards), (3) Terminal and Connector Pin Soldering (Insulation Removal, Wire Tinning and Soldering to Turret Terminals: Soldering to Hook and Pierced Tab Terminals: Soldering to Bifurcated Terminals: Soldering Connector Pins), and (4) Micro-Electronic Circuit Maintenance Techniques (Introduction to Micro-Electronic Circuit Boards, Microminiature Repair Task Identification and Procedural Analysis, Micro-Electronic Circuit Conformal Coating Removal and Desoldering Techniques, Micro-Electronic Circuit Soldering Techniques). The curriculum outline and lesson plans give the instructor this information: time allocation, training equipment, training aids, text required, references, terminal objective, enabling objectives, and outline of instruction with instructor and student activities. The student's guide contains note-taking, assignment, and job sheets. A performance test booklet is also included. (YIP)

ED193519

A Competency-Based Course In  
Job-Seeking and Job-Survival Skills

Prepared Under A Grant From The  
Berks County Employment and Training Office  
124 South Fifth Street  
Reading, PA 19602

Fred Heffner  
Ruth Littlejohn  
Terry Knox

U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRO-  
DUCED EXACTLY AS RECEIVED FROM  
THE PERSON OR ORGANIZATION ORIGIN-  
ATING IT. POINTS OF VIEW OR OPINIONS  
STATED DO NOT NECESSARILY REPRESENT  
OFFICIAL NATIONAL INSTITUTE OF  
EDUCATION POSITION OR POLICY

Reading Area Community College  
P.O. Box 1706  
Reading, PA 19603

"PERMISSION TO REPRODUCE THIS  
MATERIAL HAS BEEN GRANTED BY

F. Heffner

TO THE EDUCATIONAL RESOURCES  
INFORMATION CENTER (ERIC)."

October, 1980

CE027069

## MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

## The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

### FOR FURTHER INFORMATION ABOUT Military Curriculum Materials

#### WRITE OR CALL

Program Information Office  
The National Center for Research in Vocational  
Education  
The Ohio State University  
1960 Kenny Road, Columbus, Ohio 43210  
Telephone: 614/486-3655 or Toll Free 800/  
848-4815 within the continental U.S.  
(except Ohio)



THE NATIONAL CENTER  
FOR RESEARCH IN VOCATIONAL EDUCATION  
The Ohio State University, 1960 Kenny Road, Columbus, Ohio 43210  
Tel. (614) 486-3655  
Cable: CTRVOCEDUS/COLUMBUS OHIO

## Military Curriculum Materials for Vocational and Technical Education

Information and Field  
Services Division

The National Center for Research  
in Vocational Education





I. Lesson Plan: Job Interview.....	135
Activity 1: Interview Checklist.....	136
J. Lesson Plan: Post-Interview Critique.....	137
Activity 1: Interview Critique.....	138
VII. Learning Activities: Job Survival Units.....	140
A. Lesson Plan: Attitudes.....	140
Activity 1: Job Survival Attitudes Quiz.....	141
Activity 2: Job Survival Attitudes Quiz.....	142
B. Lesson Plan: Goal Setting.....	143
Activity 1: Job Survival Personal Goals Quiz.....	144
C. Lesson Plan: Communications.....	145
Activity 1: Communication Quiz.....	146
Activity 2: Communication Problem-Solving.....	147
D. Lesson Plan: General Skills.....	148
Activity 1: Skills Employers Seek.....	149
Activity 2: Tips for Keeping a Job.....	150
Activity 3: First Week on Job Tasks.....	151
Activity 4: Interpersonal Problem-Solving.....	152
Activity 5: Time Management.....	153
E. Lesson Plan: Job Survival Tools.....	155
Activity 1: Organizational Chart.....	156
Activity 2: Job Description.....	157
Activity 3: Performance Appraisal.....	159
Activity 4: Company Policy.....	160
Activity 5: Job Acceptance Letter.....	170
F. Lesson Plan: Job Etiquette.....	171
Activity 1: Letter of Resignation.....	172
Activity 2: Suggested Procedures for Leaving the Job.....	173
VIII. Course Evaluation.....	174
IX. Appendices.....	176
Appendix A: Welcome to RACC/TRAC.....	177
Appendix B: Mastery Log -- Competencies.....	178
Appendix C: Time Sheet.....	190
Appendix D: Employability Profile.....	191
Appendix E: Speakers.....	192

## Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

### Project Staff:

Wesley E. Budke, Ph.D., Director  
National Center Clearinghouse

Shirley A. Chase, Ph.D.  
Project Director

## What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

Agriculture	Food Service
Aviation	Health
Building & Construction	Heating & Air Conditioning
Trades	Machine Shop
Clerical Occupations	Management & Supervision
Communications	Meteorology & Navigation
Drafting	Photography
Electronics	Public Service
Engine Mechanics	

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

## How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

### CURRICULUM COORDINATION CENTERS

#### EAST CENTRAL

Rebecca S. Douglass  
Director  
100 North First Street  
Springfield, IL 62777  
217/782-0759

#### MIDWEST

Robert Patton  
Director  
1516 West Sixth Ave.  
Stillwater, OK 74704  
405/377-2000

#### NORTHEAST

Joseph F. Kelly, Ph.D.  
Director  
225 West State Street  
Trenton, NJ 08625  
609/292-6562

#### NORTHWEST

William Daniels  
Director  
Building 17  
Airdustrial Park  
Olympia, WA 98504  
206/753-0879

#### SOUTHEAST

James F. Shill, Ph.D.  
Director  
Mississippi State University  
Drawer DX  
Mississippi State, MS 39762  
601/325-2510

#### WESTERN

Lawrence F. H. Zane, Ph.D.  
Director  
1776 University Ave.  
Honolulu, HI 96822  
808/948-7834

## II. COURSE OVERVIEW

The term "work readiness" indicates that an individual has attained the skills necessary to obtain and maintain an occupation which may lead to a meaningful, satisfying, and productive working career. In order to reach this status of "work readiness", the trainee has to acquire technical skills, develop a positive attitude toward work, and develop job-seeking and job-survival skills. The Working Class is designed to provide the trainee with job-seeking and job-survival skills.

The job-seeking section of the Working Class will emphasize the importance of a positive work attitude and effective job-seeking skills. At the completion of this section, the participant will be able to identify positive work attitudes and demonstrate application completion, resume preparation, interview skills, and job search techniques.

This section will require approximately 80 study hours; the following topics will be covered:

- Attitudes
- Goal Setting
- Job Preference and Suitability
- Employment Resources
- Pre-Application Skills
- Job Application Skills
- Job-Search Skills
- Post-Interview Critique Format

The job survival skills section concentrates on those skills necessary to keep a job. At the completion of this section, the trainee will be able to identify skills necessary to maintain a job.

This section will require approximately 30 hours; the following topics will be covered:

Grades 11 - adult

Vocational Curriculum  
Coordination Centers

X Materials are recommended but not provided.

Course Description:

This course provides maintenance personnel with the latest methods to disassemble, repair and solder miniature printed circuits; components, terminals, solderable connectors, circuit board laminates, conductors and replace electronic components on microminiature single and double sided printed circuit boards and the proper preventive maintenance procedures for the repair station and its associated components.

Unit 1 - Introduction to the School and Course contains 3 lessons covering 6 hours of instruction:

- Introduction to the Course
- Introduction to High Reliability Soldering
- Preventive Maintenance of the 2M Repair Station

Unit 2 - Printed Circuit Board Repair - contains 4 lessons including 44 hours of instruction:

- Conformal Coating Removal
- Desoldering Printed Circuit Board Components
- Printed Circuit Board Component Installation and Soldering
- Repair of Damaged Printed Circuit Boards

Unit 3 - Terminal and Connector Pin Soldering - contains 4 lessons covering 35 hours of instruction:

- Insulation Removal, Wire Tinning and Soldering to Turret Terminals
- Soldering to Hook and Pierced Tab Terminals
- Soldering to Bifurcated Terminals
- Soldering Connector Pins

Unit 4 - Micro-Electronic Circuit Maintenance Techniques - includes 4 lessons containing 33 hours of instruction:

- Introduction to Micro-Electronic Circuit Boards
- Microminiature Repair Task Identification and Procedural Analysis
- Micro-Electronic Circuit Conformal Coating Removal and Desoldering Techniques
- Micro-Electronic Circuit Soldering Techniques

This course includes a curriculum outline and lesson plans which give the instructor the following information: Time allocation, training equipment, training aids, text required, references, terminal objective and enabling objectives. Student materials included a student guide and a performance test booklet. The publication NHB 5300.4(3A) has been included in the course, as it is required in the curriculum outline. Please note that lesson 1 of unit 1 has been omitted because of military specific materials.

MINIATURE/MICROMINIATURE ELECTRONICS REPAIR  
A-100-0034

CLASSROOM COURSE

TABLE OF CONTENTS

<u>Volume</u>	<u>Page</u>
Curriculum Outline	4
Instructor's Guide, Unit 1	40
Instructor's Guide, Unit 2	146
Instructor's Guide, Unit 3	394
Instructor's Guide, Unit 4	554
Student's Guide	720
Requirements for Soldered Electrical Connections	874
Performance Test Booklet	923

Note: Lesson 1 of Unit 1 has been omitted because of military specific materials.

4  
CNTT W-100-00348

CURRICULUM OUTLINE  
FOR  
MINIATURE/MICROMINIATURE ELECTRONIC REPAIR (2M) PROGRAM

PREPARED BY  
FLEET TRAINING CENTER  
NORFOLK, VIRGINIA 23511

A-100-0034

PREPARED FOR  
CHIEF OF NAVAL TECHNICAL TRAINING

MAY 1979

UNCLASSIFIED

7960P





DEPARTMENT OF THE NAVY  
CHIEF OF NAVAL TECHNICAL TRAINING  
NAVAL AIR STATION MEMPHIS (75)  
MILLINGTON, TENNESSEE 38054

LETTER OF PROMULGATION

1. The curriculum outline for the Miniature/Microminiature Electronic Repair (2M) Program Course A-100-0034, is a control document that sets the time allocation and sequence of instruction for the course. Contained within are the time allocations for each unit lesson topic of the course and the learning objectives to be achieved during each.
2. This curriculum outline supersedes any previously developed curriculum outline for this course and is effective upon receipt.
3. User commands are invited to submit explicit comments and/or recommendations concerning this course to the Chief of Naval Technical Training (N313), Naval Air Station Memphis (75), Millington, Tennessee 38054.

J. W. SELLERS  
Assistant Chief of Staff  
for Surface Warfare and Basic Training

## COURSE DATA PAGE

## 1. COURSE MISSION:

To provide maintenance personnel with the latest methods to disassemble, repair and solder miniature printed circuits, components, terminals, solderable connectors, circuit board laminates, conductors and replace electronic components on microminiature single and double sided printed circuit boards and the proper preventive maintenance procedures for the repair station and its associated components as required for initial certification in the NAVSEA (2M) Program.

## 2. COURSE LENGTH:

120 Instructional Periods  
19 Days

## 3. LOCATIONS AT WHICH TAUGHT:

Fleet Training Center, Norfolk, VA  
Service Schools Command, San Diego, CA

## 4. CLASS CAPACITY:

	<u>Norfolk</u>	<u>San Diego</u>
Normal Load	12	12
Maximum Capacity	12	12

## 5. INSTRUCTOR REQUIREMENTS:

3 Electrical/Electronic E-6 or above

## 6. INSTRUCTIONAL PROGRAM MANAGER:

Chief of Naval Technical Training

## 7. QUOTA CONTROL:

Quota Control, Fleet Training Center, Norfolk, VA  
Quota Control, Service Schools Command, San Diego, CA

## 8. IMPLEMENTATION DATE:

May 1979

## 9. PRIMARY MODE OF INSTRUCTION:

Group-paced

10. PRECEDING CURRICULUM OUTLINE:

November 1976

11. INSTRUMENTS AND PROCEDURES FOR MEASURING STUDENT PERFORMANCE:

Performance Tests (Final Product)

12. PERSONNEL QUALIFICATIONS STANDARDS (PQS):

None developed

8

## FOREWORD

This document was prepared for submission to higher authority for approval. The curriculum outline serves as a planning document for development of specific training materials to be used to conduct the course of instruction. It is in outline form listing course units and lesson topics in sequential order with accompanying learning objectives both terminal and enabling. The outline organizes the course of instruction for the Miniature/Micro-Miniature Electronic Repair (2M) Program and ensures that all required subject matter is adequately covered in the course. This curriculum outline consists of front matter, the outline of instruction and annex.

To eliminate repetitious verbage in the conditions and standards of the topic objectives of this course involving high reliability soldering techniques and standards/specifications, the following information outlined in MIL-STD-454E and MIL-S-45743( ), will apply at all times:

### High Reliability Soldering Techniques -

- a. Thoroughly clean area to be soldered - remove oxidation and dirt using ink type eraser and solvent.
- b. Apply flux to area to be soldered - flux cored solder or external flux.
- c. Proper heat application - correctly prepared soldering iron to the mass to be soldered.
- d. Proper application of solder - use heat shunt if needed, form solder bridge and apply solder to form solder bond.
- e. Clean after soldering - remove all flux residues using an approved solvent.

### High Reliability Soldering Standards/Specifications -

- a. Solder joint possess proper quantity of solder
  - (1) Concave fillets on all connections
  - (2) Lead or wire strand contour visible

- (3) No bare metal or copper visible
- (4) No wicking of solder under wire insulation
- b. Solder finish show no defects
  - (1) Bright, gleaming and mirror-like finish
  - (2) No pits, holes, peaks or fractures
  - (3) No chalky, sandy or irregular surfaces
- c. Proper wetting action
  - (1) Smooth feathering of all solder edges
  - (2) No bays or crevices in the edge of the solder flow
  - (3) No spillage of solder over sides of joints or terminals
  - (4) Complete solder flow to the edge of the pad or terminal
- d. Proper lead termination
  - (1) Excess lead cut off with a flush cutting tool
  - (2) Clinched termination lead length shall be not less than the radius of the pad and not greater than the diameter of the pad
  - (3) All clinched terminations must be bent in the direction of the run; semi-clinch to 45 degrees; full clinch 90 degrees and flush with the run
  - (4) Straight through termination lead length shall be not less than one lead diameter and not more than two lead diameters above the board surface.
  - (5) Lead will not overhang run or pad area.
- e. No board, conductor or component damage
  - (1) No indication of an overheated board
  - (2) No conductor delamination
  - (3) No conductor nicks and scratches
  - (4) No component degradation

## TABLE OF CONTENTS

FRONT MATTER	PAGE
Letter of Promulgation .....	i
Student Data Sheet.....	iv
Foreword.....	v
Table of Contents.....	ix
OUTLINE OF INSTRUCTION	
<u>Unit 1.0 - Introduction to the School and Course</u> .....	1
Lesson Topic 1.2 - Introduction to the Course.....	3
Lesson Topic 1.3 - Introduction to High Reliability Soldering.....	4
Lesson Topic 1.4 - Preventive Maintenance of the 2M Repair Station.....	5
<u>Unit 2.0 - Printed Circuit Board Repair</u> .....	6
Lesson Topic 2.1 - Conformal Coating Removal.....	7
Lesson Topic 2.2 - Desoldering Printed Circuit Board Components.....	8
Lesson Topic 2.3 - Printed Circuit Board Component Installation and Soldering.....	10
Lesson Topic 2.4 - Repair of Damaged Printed Circuit Boards-	12
<u>Unit 3.0 - Terminal and Connector Pin Soldering</u> .....	14
Lesson Topic 3.1 - Soldering to Turret Terminals.....	15
Lesson Topic 3.2 - Soldering to Hook and Pierced Tab Terminals.....	17

*Note: Lesson Topic 1.1 and sections of the Front Matter have been omitted because of military specific materials.*

	PAGE
Lesson Topic 3.3 - Soldering to Bifurcated Terminals-----	19
Lesson Topic 3.4 - Soldering Connector Pins-----	21
<u>Unit 4.0 - Micro-Electronic Circuit Maintenance Techniques-----</u>	22
Lesson Topic 4.1 - Introduction to Micro-Electronic Circuit Boards-----	23
Lesson Topic 4.2 - Microminiature Repair Task Identification and Procedural Analysis---	24
Lesson Topic 4.3 - Micro-Electronic Circuit Conformal Coating Removal and Desoldering Techniques-----	25
Lesson Topic 4.4 - Micro-Electronic Circuit Soldering Techniques-----	26
Class Schedules-----	27
ANNEX	
Training Equipment List-----	30
Training Aids-----	31
Training Aids Equipment-----	32
Training Materials List-----	33
References-----	34



**LESSON TOPIC 1.2 INTRODUCTION TO THE COURSE**

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Periods	0.0 Periods

**TERMINAL OBJECTIVE**

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic: NONE

**ENABLING OBJECTIVES**

Supported Entirely by this Lesson Topic:

- 1.2.1 COMPLY with classroom procedures, regulations, schedules, scholastic requirements and special instructional activities in accordance with information outlined in the Student's Guide. Compliance to the regulations, schedules and scholastic requirements as outlined is required to obtain a satisfactory completion of the course. (INFO)

Supported Partially by this Lesson Topic: NONE

**LESSON TOPIC 1.3 INTRODUCTION TO HIGH RELIABILITY SOLDERING**

Instructional Periods Allotted this Lesson Topic:

Classroom

Laboratory

2.0 Periods

0.0 Periods

**TERMINAL OBJECTIVE**

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 1.0 INSTALL electronic components on single-sided and double-sided printed circuit boards using approved mounting styles, proper terminations and high reliability soldering techniques. Complete installation must meet acceptable reliability and quality specifications, while observing all personnel and equipment safety precautions.

**ENABLING OBJECTIVE**

Supported Entirely by this Lesson Topic:

- 1.3.1 PERFORM visual inspections of printed circuit board solder connections and DETERMINE if the physical appearance, the quantity of solder and the internal structure of the connections meet the acceptable level of standards for high reliability soldering requirements. Each student will be required to inspect their completed work throughout the course and determine that it is reliable and does not require rework, prior to submission for evaluation.

Supported Partially by this Lesson Topic: NONE

**LESSON TOPIC 1.4 PREVENTIVE MAINTENANCE OF THE 2M REPAIR STATION**

Instructional Periods Allotted this Lesson Topic:

Classroom                      Laboratory

1.0 Period                      1.0 Period

**TERMINAL OBJECTIVE**

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 1.0 INSTALL electronic components on single-sided and double-sided printed circuit boards using approved mounting styles, proper terminations and high reliability soldering techniques. Complete installation must meet acceptable reliability and quality specifications, while observing all personnel and equipment safety precautions.

**ENABLING OBJECTIVE**

Supported Entirely by this Lesson Topic:

- 1.4.1 PERFORM the daily and weekly preventive maintenance actions on the 2M Repair Station and associated equipment as outlined in the SX-300 Maintenance Instructions and associated equipment manuals, while observing all personnel and equipment safety precautions.

Supported Partially by this Lesson Topic: NONE

**UNIT 2.0 PRINTED CIRCUIT BOARD REPAIR**

Instructional Periods Allotted this Unit:

Classroom	Laboratory
9.0 Periods	35.0 Periods

**TERMINAL OBJECTIVES**

Supported Entirely by this Unit:

- 2.0 REMOVE various types of conformal coatings from printed circuit boards using the chemical, heat and abrasive methods of removal with no damage or degradation to components or the printed circuit boards and observing all personnel and equipment safety precautions.
- 3.0 REMOVE components from selected printed circuit boards using the wicking, manual and motorized solder extraction methods of desoldering with no damage or degradation to the components or printed circuit boards. All personnel and equipment safety precautions must be observed.
- 4.0 REPAIR damaged printed circuit board conductors, pads, eyelets and laminates using the proper tools, accepted printed circuit repair procedures and high reliability soldering techniques to meet original reliability and configuration specifications, with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

Supported Partially by this Unit and Unit 1.0

- 1.0 INSTALL electronic components on single-sided and double-sided printed circuit boards using approved mounting styles, proper terminations and high reliability soldering techniques. Complete installation must meet acceptable reliability and quality specifications, while observing all personnel and equipment safety precautions.

## LESSON TOPIC 2.1 CONFORMAL COATING REMOVAL

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Periods	6.0 Periods

### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic:

- 2.0 REMOVE various types of conformal coatings from printed circuit boards using the chemical, heat and abrasive methods of removal with no damage or degradation to components or the printed circuit boards and observing all personnel and equipment safety precautions.

Supported Partially by this Lesson Topic: NONE

### ENABLING OBJECTIVES

Supported Entirely by this Lesson Topic:

- 2.1.1 IDENTIFY the conformal coatings on three out of four instructor provided printed circuit boards and DETERMINE the best method of removal of each coating, utilizing the information on Chart 1 - Conformal Coating Characteristics and Chart 2 - Conformal Coating Removal Techniques, in the Student's Guide.
- 2.1.2 REMOVE the conformal coatings from two out of three designated components on three instructor provided printed circuit boards using the chemical, heat and/or abrasive methods of removal prior to the eighth day of the course. Coating must be removed from all lead/pad areas and along all sides of the components to a point on or slightly below the widest profile of the body with no damage or degradation to components or the printed circuit boards. All personnel and equipment safety precautions must be observed.

Supported Partially by this Lesson Topic: NONE

## LESSON TOPIC 2.2 DESOLDERING PRINTED CIRCUIT BOARD COMPONENTS

Instructional Periods Allotted this Lesson Topic:

Classroom

Laboratory

2.0 Periods

6.0 Periods

### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic:

- 3.0 REMOVE components from selected printed circuit boards using the wicking, manual and motorized solder extraction methods of desoldering with no damage or degradation to the components or printed circuit boards, observing all personnel and equipment safety precautions.

Supported Partially by this Lesson Topic: NONE

### ENABLING OBJECTIVES

Supported Entirely by this Lesson Topic:

- 2.2.1 REMOVE a minimum of two out of three selected components from an instructor provided single-sided printed circuit board using the wicking method of desoldering, as demonstrated, prior to the eighth day of the course. Removal must be completed without causing degradation or damage to components or printed circuit board. All personnel and equipment safety precautions must be observed.
- 2.2.2 REMOVE a minimum of two out of three selected components from an instructor provided single-sided circuit board using the manual vacuum method of desoldering, as demonstrated, prior to the eighth day of the course. Removal must be completed without causing degradation or damage to components or printed circuit board. All personnel and equipment safety precautions must be observed.
- 2.2.3 REMOVE a minimum of two out of three selected components from an instructor provided double-sided printed circuit board using the motorized vacuum method of desoldering, as demonstrated, prior to the eighth day of the course. Removal must be completed without causing degradation or damage to components or printed circuit board. All personnel and equipment safety precautions must be observed.

- 2.2.4 DESOLDER and REMOVE a minimum of one out of two designated components from each of the three printed circuit boards used during conformal coating removal. Removal of components must be completed prior to the ninth day of the course, using an acceptable solder extraction method, without causing degradation or damage to components or circuit boards. All personnel and equipment safety precautions must be observed.

Supported Partially by this Lesson Topic: NONE



## LESSON TOPIC 2.3 PRINTED CIRCUIT BOARD COMPONENT INSTALLATION AND SOLDERING

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Periods	14.0 Periods

### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 1.0 INSTALL electronic components on single-sided and double-sided printed circuit boards using approved mounting styles, proper terminations and high reliability soldering techniques. Complete installation must meet acceptable reliability and quality specifications, while observing all personnel and equipment safety precautions.

### ENABLING OBJECTIVES

Supported Entirely by this Lesson Topic:

- 2.3.1 SHAPE the leads of designated electronic components to be installed on single and/or double-sided printed circuit boards, without damaging leads or components. Components shall be centered between the lead mounting points, mounted flush on the board with no visible stress on the leads and all identification markings readable, when possible.
- 2.3.2 INSTALL prepared components on a single-sided printed circuit board utilizing the required tools and high reliability soldering techniques. Each student will be required to satisfactorily install a minimum of two out of three flush mounted/semi-clinched terminated, two out of three flush mounted/full clinched terminated, one out of two stress relief mounted/straight thru terminated and one out of two vertically mounted/straight thru terminated components prior to the tenth day of the course. All completed work must meet the acceptable standards for high reliability soldering with no degradation or damage to the components or printed circuit board. All personnel and equipment safety precautions must be observed.

- 2.3.3 INSTALL prepared components on a double-sided printed circuit board utilizing the proper tools and high reliability soldering techniques. Each student will be required to satisfactorily install a minimum of five out of seven components prior to the tenth day of the course. All completed work must meet the acceptable standards for high reliability soldering with no degradation or damage to the components or printed circuit board. All personnel and equipment safety precautions must be observed.

Supported Partially by this Lesson Topic: NONE

## LESSON TOPIC 2.4 REPAIR OF DAMAGED PRINTED CIRCUIT BOARDS

Instructional Periods Allotted this Lesson Topic:

Classroom

Laboratory

3.0 Periods

9.0 Periods

### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic:

- 4.0 REPAIR damaged printed circuit board conductors, pads, eyelets and laminates using the proper tools, accepted printed circuit repair procedures and high reliability soldering techniques to meet original reliability and configuration specifications, with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

Supported Partially by this Lesson Topic: NONE

### ENABLING OBJECTIVES

Supported Entirely by this Lesson Topic:

- 2.4.1 IDENTIFY the four types of damage common to printed circuit boards, when given a sample of each, DETERMINE the extent of repairs required and SELECT the proper repair technique to be utilized to restore each board to meet its original reliability specifications.
- 2.4.2 PERFORM a laminate repair of a burned area on an instructor provided printed circuit board using the patching and/or rebuilding technique, required tools and equipment necessary to restore the printed circuit board to meet the original reliability and configuration specifications, prior to the eleventh day of the course. The completed repair must meet the following standards with no visible defects that would require rework while observing all personnel and equipment safety precautions:
- a. Patch repair (when damage does not extend completely through the laminate) - Edges will be beveled and undercut; no voids or bubbles will exist in the repair material; surface will be smooth and level with original laminate.

- b. Rebuilding repair (when damage extends completely through the laminate) - Same standards as patch repair and if replacement piece is used it will not touch original laminate at any point.

#### 2.4.3

REPAIR designated conductor damage on an instructor provided printed circuit board using the required tools, equipment, accepted conductor repair procedures and high reliability soldering techniques. A minimum of one out of two flow repairs, one out of two lap repairs, one out of two clinch staple repairs and one out of two pad replacement repairs with an eyelet set in the pad will be required prior to the eleventh day of the course. The completed repairs must meet the acceptable standards for high reliability soldering and the following specifications with no visible reliability defects while observing all personnel and equipment safety precautions:

- a. Flow repair - Solder must extend a minimum of twice the run width on each side of the damaged area.
- b. Lap repair - Repair material must overlap a minimum of two run widths on each side of the damaged area and lay flat without overhanging the original run.
- c. Clinch staple repair - drilled hole diameter must not exceed more than one half the width of the run, be centered on the run and in undamaged run material.
- d. Pad replacement with eyelet set in pad - Replacement pad and run must be the same size and shape as the original; pad must lay flat and be completely bonded to the board laminate; no splits will extend into barrel of the eyelet; eyelet heads must remain round in shape, must be secured firmly in place and must not extend over the original pad or run area.

Supported Partially by this Lesson Topic: NONE

**UNIT 3.0 TERMINAL AND CONNECTOR PIN SOLDERING**

Instructional Periods Allotted this Unit:

Classroom

Laboratory

8.0 Periods

27.0 Periods

**TERMINAL OBJECTIVE**

Supported Entirely by this Unit:

- 5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins utilized in miniature electronic circuits, using the required tools and equipment, acceptable wire insulation clearance, wire position specifications and high reliability soldering techniques and standards with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

Supported Partially by this Unit: NONE

# LESSON TOPIC 3.1 INSULATION REMOVAL, WIRE TINNING AND SOLDERING TO TURRET TERMINALS

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Periods	6.0 Periods

## TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins utilized in miniature electronic circuits, using the required tools and equipment, acceptable wire insulation clearance, wire position specifications and high reliability soldering techniques and standards with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

## ENABLING OBJECTIVE

Supported Entirely by this Lesson Topic:

- 3.1.1 REMOVE the required amount of insulation from wires of various gauges and composition to be used in high reliability soldering of miniature electronic circuit terminals and connectors, utilizing thermal type wire strippers, without causing any damage or degradation to the insulation or wire. All personnel and equipment safety precautions must be observed.
- 3.1.2 PREPARE wires to be solder connected to miniature electronic circuit terminals and connector pins by cleaning and tinning, maintaining the original lay of the wire strands and keeping the contour of the wire strands visible with no solder wicking under the insulation. All personnel and equipment safety precautions must be observed.
- 3.1.3 PREPARE miniature electronic circuit turret terminals for soldering by cleaning and tinning them without causing any visible damage and ensuring thorough solder wetting of the terminals. All personnel and equipment safety precautions must be observed.

## 3.1.4

CONNECT prepared wires to miniature electronic circuit turret terminals completing a minimum of two out of three single entry and one out of two double entry connections, using the required tools and high reliability soldering techniques, prior to the eleventh day of the course. Each wire shall set firmly against the terminal post, be flat on the pad throughout a minimum 180 degree to a maximum 270 degree wire wrap and have proper insulation clearance with no visible reliability defects that would require rework. On double wire connections the wires must be wrapped in the same direction, trimmed to the same length and positioned directly one above the other. The acceptable wire insulation clearance is to be no greater than two times the wire diameter (including the insulation) measured from the insulation to the entry fillet, to the minimum of the insulation not being imbedded in the solder joint. All personnel and equipment safety precautions must be observed.



## LESSON TOPIC 3.2 SOLDERING TO HOOK AND PIERCED TAB TERMINALS

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Periods	6.0 Periods

### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins utilized in miniature electronic circuits, using the required tools and equipment, acceptable wire insulation clearance, wire position specifications and high reliability soldering techniques and standards with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

### ENABLING OBJECTIVES

Supported Entirely by this Lesson Topic:

- 3.2.1 PREPARE miniature electronic circuit hook and pierced tab terminals for soldering by cleaning and tinning them, without causing any visible damage and ensuring thorough solder wetting of the terminals. All personnel and equipment safety precautions must be observed.
- 3.2.2 CONNECT prepared wires to prepared miniature electronic circuit hook terminals completing a minimum of two out of three single entry and one out of two double entry connections using the required tools and high reliability soldering techniques, prior to the twelfth day of the course. It is required that the wires be in firm contact with the terminals and the wire entry be vertical to the terminal mounting surface. Each wire shall be wrapped on the terminals throughout a minimum of a 90 degree to a maximum of 270 degree wire wrap, flush cut and have the acceptable insulation clearance with no visible reliability defects that would require rework. On double wire connections the wires must be wrapped in alternating directions. All personnel and equipment safety precautions must be observed.

- 3.2.3 CONNECT prepared wires to prepared miniature electronic circuit pierced tab terminals completing a minimum of two out of three single entry and one out of two double entry connections using the required tools and high reliability soldering techniques, prior to the twelfth day of the course. The wires must be in firm contact with the terminals throughout a minimum wire wrap of 90 degrees to a maximum of 270 degrees, flush cut and have acceptable insulation clearance with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

Supported Partially by this Lesson Topic: NONE

### LESSON TOPIC 3.3 SOLDERING TO BIFURCATED TERMINALS

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Periods	6.0 Periods

#### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins utilized in miniature electronic circuits, using the required tools and equipment, acceptable wire insulation clearance, wire position specifications and high reliability soldering techniques and standards with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

#### ENABLING OBJECTIVES

Supported Entirely by this Lesson Topic:

- 3.3.1 PREPARE miniature electronic circuit bifurcated terminals for soldering by cleaning and tinning them without causing any damage and ensuring thorough solder wetting of the terminals.
- 3.3.2 CONNECT prepared wires to prepared miniature electronic circuit bifurcated terminals completing a minimum of two out of three single side entry and one out of two double side entry connections using the required tools, equipment and high reliability soldering techniques, prior to the twelfth day of the course. All completed work must meet the acceptable standards for high reliability soldering, each wire have the acceptable insulation clearance and all connections meet the following wire position specifications, with no visible damage or degradation that would require rework while observing all personnel and equipment safety precautions:
  - a. Single side entry - Wire wrap shall be 90 degrees, the wire must be in contact with the surface of the terminal base, wrapped around one ear of the terminal, in contact with the inside edge and one side of the ear and flush cut at the edge of the base without overhanging.

- b. Double side entry - Has same specifications as single side entry with the following requirements: both wires enter from the same side, parallel to each other and the second wire must be wrapped on the opposite ear but not in contact with the terminal base.

Supported Partially by this Lesson Topic: NONE

# LESSON TOPIC 3.4 SOLDERING CONNECTOR PINS

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
2.0 Periods	9.0 Periods

## TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins utilized in miniature electronic circuits, using the required tools and equipment, acceptable wire insulation clearance, wire position specifications and high reliability soldering techniques and standards with no visible reliability defects that would require rework. All personnel and equipment safety precautions must be observed.

## ENABLING OBJECTIVES

Supported Entirely by this Lesson Topic:

- 3.4.1 PREPARE miniature electronic circuit connector pins for soldering by cleaning and tinning the pins without causing any visible damage and ensuring thorough solder wetting of the connectors.
- 3.4.2 CONNECT prepared wires to prepared miniature electronic circuit connector pins completing a minimum of three out of four single entry connections using the required tools and high reliability soldering techniques prior to the thirteenth day of the course. The wire must be bottomed in the cup, aligned with the axis of the cup, have a circular concave fillet where the wire enters the cup, wire strands not visible, have no solder spillage on the outer walls and acceptable insulation clearance with no visible reliability or quality defects that would require rework. All personnel and equipment safety precautions must be observed.

Supported Partially by this Lesson Topic: NONE

**UNIT 4.0 MICRO-ELECTRONIC CIRCUIT MAINTENANCE TECHNIQUES**

Instructional Periods Allotted this Unit:

Classroom                      Laboratory

10.0 Periods    23.0 Periods

**TERMINAL OBJECTIVES**

Supported Entirely by this Unit:

- 6.0 REMOVE selected components from conformal coated micro-electronic printed circuit boards using the correct conformal coating removal method and micro-electronic desoldering technique for each component. Removal of components must be performed with no visible damage or degradation to the components or printed circuitry while observing all personnel and equipment safety precautions.
- 7.0 INSTALL electronic components on micro-electronic printed circuit boards using the correct tools, approved mounting styles, proper terminations and high reliability soldering techniques. Installations must meet acceptable reliability and quality specifications while observing all personnel and equipment safety precautions.

Supported Partially by this Unit: NONE

## LESSON TOPIC 4.1 INTRODUCTION TO MICRO-ELECTRONIC CIRCUIT BOARDS

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
1.0 Periods	0.0 Periods

## TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 6.0 REMOVE selected components from conformal coated micro-electronic printed circuit boards using the correct conformal coating removal method and micro-electronic desoldering technique for each component. Removal of components must be performed with no visible damage or degradation to the components while observing all personnel and equipment safety precautions.

## ENABLING OBJECTIVE

Supported Entirely by this Lesson Topic:

- 4.1.1 PERFORM visual inspection of miniature/microminiature electronic circuit boards, their solder connections and conformal coatings. DETERMINE if the physical appearance, quantity of solder, internal structure of the connections and composition of the conformal coating meet the construction characteristics that would require micro-electronic high level repair skills and handling procedures.

Supported Partially by this Lesson Topic: NONE

## LESSON TOPIC 4.2 MICROMINIATURE REPAIR TASK IDENTIFICATION AND PROCEDURAL ANALYSIS

Instructional Periods Allotted this Lesson Topic:

Classroom	Laboratory
4.0 Periods	0.0 Periods

### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 6.0 REMOVE selected components from conformal coated micro-electronic printed circuit boards using the correct conformal coating removal method and micro-electronic desoldering technique for each component. Removal of components must be performed with no visible damage or degradation to the components or printed circuitry while observing all personnel and equipment safety precautions.

### ENABLING OBJECTIVE

Supported Entirely by this Lesson Topic:

- 4.2.1 IDENTIFY by visual inspection and work piece analysis of an instructor selected damaged micro-electronic circuit board, the overall repair task to be performed to restore the board to meet its original configuration specifications, without causing any additional damage or degradation.

Supported Partially by this Lesson Topic: NONE



### LESSON TOPIC 4.3 MICRO-ELECTRONIC CIRCUIT CONFORMAL COATING REMOVAL AND DESOLDERING TECHNIQUES

Instructional Periods Allotted this Lesson Topic:

Classroom

Laboratory

2.0 Periods

10.0 Periods

#### TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic: NONE

Supported Partially by this Lesson Topic:

- 6.0 REMOVE selected components from conformal coated micro-electronic printed circuit boards using the correct conformal coating removal method and micro-electronic desoldering technique for each component. Removal of components must be performed with no visible damage or degradation to the components or printed circuitry while observing all personnel and equipment safety precautions.

#### ENABLING OBJECTIVE

Supported Entirely by this Lesson Topic:

- 4.3.1 EVALUATE the tasks to be performed and DETERMINE the proper conformal coating removal method and desoldering technique to be used on instructor selected micro-electronic printed circuit boards, to remove designated components. The evaluation and determination made for each situation and task, should ensure no additional damage or degradation to the components or boards.
- 4.3.2 REMOVE a minimum of two out of three dual-in-line type, two out of three flat pack type and two out of three TO-5 type IC's from instructor selected conformal coated micro-electronic printed circuit boards, using the correct conformal coating removal method and micro-electronic desoldering technique for each component. Removal of conformal coated components must be performed with no visible damage or degradation to the components or printed circuit boards which would require rework, prior to the fourteenth day of the course. All personnel and equipment safety precautions must be observed.

Supported Partially by this Lesson Topic: NONE

# LESSON TOPIC 4.4 MICRO-ELECTRONIC CIRCUIT SOLDERING TECHNIQUES

Instructional Periods Allotted this Lesson Topic:

Classroom

Laboratory

3.0 Periods

13.0 Periods

## TERMINAL OBJECTIVE

Supported Entirely by this Lesson Topic:

- 7.0 INSTALL electronic components on micro-electronic printed circuit boards using the correct tools, approved mounting styles, proper terminations and high reliability soldering techniques. Installations must meet acceptable reliability and quality specifications while observing all personnel and equipment safety precautions.

Supported Partially by this Lesson Topic: NONE

## ENABLING OBJECTIVE

Supported Entirely by this Lesson Topic:

- 4.4.1 INSTALL a minimum of one out of two dual-in-line type, one out of two flat pack type and one out of two TO-5 type IC's on instructor designated micro-electronic printed circuit boards using the proper tools, approved mounting styles and terminations and high reliability soldering techniques, prior to the fifteenth day of the course. All completed work must meet the acceptable standards for high reliability soldering with no damage or degradation to the components or printed circuitry that would require rework, while observing all personnel and equipment safety precautions.
- 4.4.2 IDENTIFY the proper conformal coating that should be applied to various micro-electronic printed circuit boards. Identification must assure compatibility and the functional requirements of the original coating material specifications.

Supported Partially by this Lesson Topic: NONE

## ANNEX

## TRAINING EQUIPMENT LIST

<u>TYPE DESIGNATOR</u>	<u>NOMENCLATURE</u>	<u>NATIONAL STOCK NR.</u>	<u>QUANTITY REQUIRED</u>	<u>PER ITEM COST</u>
	MERP/2M Equipment Kit listed in AEL-2-6700-34022		12	\$3000.00
	Stereo . . . . . Microscope	NA	2	1200.00
	Pulp Reamers #10, 15, 30, 50, 70 and 90	NA	12	2.00
Dremel	Drill Press Stand and Variable Speed Moto	NA	1	

## TRAINING AIDS EQUIPMENT

<u>NOMENCLATURE</u>	<u>NATIONAL STOCK NR.</u>	<u>DEVICE DESIGNATOR NUMBER</u>	<u>QUANTITY REQUIRED</u>
Projector, Slide 2 X 2, Carousel			1
Screen, Projection Standard			1
Display Board	Various printed circuit boards constructed by the instructors.		
Video Cassette Projector (3/4")			

7989P2

30

## TRAINING AIDS

<u>NOMENCLATURE</u>	<u>NATIONAL STOCK NR.</u>	<u>DEVICE DESIGNATOR NUMBER</u>	<u>QUANTITY REQUIRED</u>
<u>35 MM Slides</u>			
Miniature Component Repair Course	Code YXH	YXH L1-S1 thru YXH L11-S20	1 each
Microminiature Electronic Repair Course	Code YXP	YXP L2-S3 YXP L1-S4 YXP L5-S1 thru YXP L9-S32 YXP L12-S1 thru YXP L12-S13	1 each
<u>Video Cassette</u>			
ZAP-Static Awareness		65197-8T-0051	1 each
<u>16mm Film</u>			
Introduction to Micro-electronic		MN-10609A	1 each

## TRAINING MATERIALS LIST

## MILITARY PUBLICATIONS

NUMBER (MILPUBS)COMPLETE TITLE

Miniature/Microminiature  
Electronic Repair (2M)  
Program Course, Student's  
Guide - 1 per student

CIVILIAN PUBLICATIONS - NONE

## REFERENCES

MILITARY PUBLICATIONS

<u>NUMBER</u>	<u>COMPLETE TITLE</u>
MIL-STD-454E	Electronic Equipment
MIL-S-45743()	Soldering Manual Type, High Reliability, Electrical, Electronic Instrument, Communication and Radar for Radar and Aerospace and Control System
NHB 5300.4(3A)	Requirement for Soldering Electrical Connections
MIL-C-47255(MI)	Coating, Protective for Printed Wiring Boards
MIL-C-47256(MI)	Coating, for Printed Wiring Boards, Application of
MIL-P-22629	Printed Wiring Boards
MIL-P-55110B	Printed Wiring Boards
MIL-F-55561A	Foil, Copper, Cladding for Printed Wiring Boards
MIL-S-46860(MI)	Soldering of Metallic Ribbon Lead Materials to Solder Coated Conductors, Process for Reflow
MIL-STD-275C	Printed Wiring for Electronic Equipment
MIL-F-20329A	Flux, Soldering Rosin Base General Purpose
QQ-S-571	Solder
NASA SP-5002	Soldering Electrical Connections 4th Edition 1967.
NASA TM X-53335	The Effect of Gold Plating on Soldered Connections 1965 NASA
NAVSEA OD46363	Handling of Micro Components and Circuits, 21 March 1977
MIL-STD-429C	Printed Wiring and Printed Circuit, Terms and Definitions
MIL-F-14256D	Flux, Soldering, Liquid (Rosin Base)
MIL-P-28809	Printed Wiring Assemblies
MIL-P-46843B	Printed Wiring Assemblies

AUTHOR (COMMERCIAL  
OR CIVILIAN PUBS)

COMPLETE TITLE, PUBLISHING COMPANY,  
EDITION, DATE

Pace Inc.  
William J. Siegel

The Pace Rework and Repair (R&R) Technology Series  
Volumes 1, 2, 4, 5, 6, 7 and 8 1971

Howard H. Manko

Solders and Soldering, McGraw-Hill Book Co.  
New York, NY Copyright 1964

Pace Inc.  
William J. Siegal

Design Guideline for Producibility and  
Repairability of Electronic Assemblies, Pace Inc.  
9337 Frazer Street, Silver Springs, MD

Clifford L. Barber

Solder - Its Fundamentals and Usage  
Third Edition, Kester Solder Company  
Copyright 1954, 61, 65

Charles A. Harper

Handbook of Materials and Processes for  
Electronics, McGraw-Hill, Copyright 1970

Clyde F. Coombs

Printed Circuit Handbook, McGraw-Hill  
Copyright 1967

Pace Inc.

Sodr-x-tractor SX300, General Operating and  
Maintenance Instructions, Copyright 1971

Dremel Mtg. Division

Dremel Moto-Tool, 1977

INSTRUCTOR'S GUIDE  
FOR  
MINIATURE/MICROMINIATURE ELECTRONIC REPAIR (2) PROGRAM

A-100-0034

PREPARED BY  
FLEET TRAINING CENTER  
NORFOLK, VIRGINIA 23511

PREPARED FOR  
CHIEF OF NAVAL TECHNICAL TRAINING  
JULY 1977

**Activities:**

1. Course Goal Setting — Each participant is asked what he/she wants to get out of the course and a consensus is established.
2. Ring Toss — Class divides into two groups. Each group takes turns throwing the ring at random. Each person then establishes goals and parameters for successful ring toss and then tosses the ring.
3. Goal Setting — Each student sets own goals and examines the various elements of goal setting.
4. Quiz — A seven question quiz is given to evaluate students' understanding of personal and work goals (both short and long range) and the importance of these types of goals in the job-search.



## TABLE OF CONTENTS

FRONT MATTER	PAGE
Cover Page-----	i
Distribution-----	iii
Record of Changes-----	iv
Table of Contents-----	v
How to Use This Instructor's Guide-----	viii

### LESSON TOPIC GUIDES

1.2 - Introduction to the Course-----	1-2-1
1.3 - Introduction to High Reliability Soldering-----	1-3-1
1.4 - Preventive Maintenance of the 2M Repair Station-----	1-4 1
2.1 - Printed Circuit Board Component Installation and Soldering-----	2-1-1
2.2 - Conformal Coating Removal-----	2-2-1
2.3 - Desoldering Printed Circuit Board Components-----	2-3-1
2.4 - Repair of Damaged Printed Circuit Boards-----	2-4-1
3.1 - Soldering to Turret Terminals-----	3-1-1

*Note: Lesson 1.1 and parts of the front matter have been omitted because of military specific materials. 18 v*

**ACTIVITY 2: RING TOSS**

This exercise is designed to contrast goal setting and pot luck.

**POT LUCK**

1. Divide the class into two groups.
2. Give each student a chance to project the number of successful rings they will toss.
3. Allow each student to toss the rings an equal number of times.

**GOAL SETTING**

1. Divide the class into two groups.
2. Give each student a chance to project the number of successful rings they will toss and the distance they will stand from the ring.
3. Allow each student to toss the rings an equal number of times.

**DISCUSSION**

1. Which process was more rewarding? Why?

3.2 - Soldering to Hook and Pierced Tab Terminals-----	3-2-1
3.3 - Soldering to Bifurcated Terminals-----	3-3-1
3.4 - Soldering Connector Pins-----	3-4-1
4.1 - Introduction to Micro-Electronic Circuit Boards-----	4-1-1
4.2 - Microminiature Repair Task Identification and Procedural Analysis-----	4-2-1
4.3 - Micro-Electronic Circuit Conformal Coating Removal and Desoldering Techniques-----	4-3-1
4.4 - Micro-Electronic Circuit Soldering Techniques-----	4-4-1

## HOW TO USE THIS INSTRUCTOR'S GUIDE

43

This "Instructor's Guide" was developed from the approved "Curriculum Outline" for the course. It is intended for use as a basic outline in classroom instruction. (For guidance purposes, you should be familiar with the Curriculum Outline.) Ample space has been provided for you to make notes that will help you in teaching the course. Thus, you can readily convert it to a set of personal "Lesson Topic Guides" by making notes and by adding supplemental pages such as marked-up "Diagram Sheets" or filled-in "Notetaking Sheets." The learning objectives and the "Outline of Instruction" included in each Lesson Topic Guide prescribe the minimum content for that lesson, and will not be modified without proper authorization.

The Lesson Topic Guides are grouped in units and provide you with the Outline of Instruction for each Lesson Topic of this course. The numbering system is consistent with that used in the Curriculum Outline. The Outline of Instruction is sequenced in the same order in which the learning objectives are listed. The pages of the Lesson Topic Guides are printed in a horizontal format for ease of use in the classroom.

The two-column Lesson Topic Guide pages contain information that will help you prepare yourself for teaching the lesson. Found therein for each Lesson Topic is the security classification, the time allotment in contact hours, and the objectives as contained in the Curriculum Outline. Also, furnished is a list of all instructional materials, the Criterion Tests required, and the homework assignments.

The three-column "Outline of Instruction"/"Instructor Activity"/"Student Activity" pages contain the Outline of Instruction, developed in sufficient depth to be used as your primary teaching document. Related instructor and student activities that enhance the learning process are also listed.

"Outline of Instruction" Column. This column contains the major points of the subject matter to be covered during the lesson, in full textbook narrative form, descriptive phrases, or key words as appropriate. In general, it outlines concepts, theories, descriptions, processes, procedures, etc. For economy, if entries are not needed in the Instructor Activity or Student Activity columns, information normally printed in the Outline of Instruction column is printed across the entire page.

"Instructor Activity" Column. This column points out activities which the instructor must carry out during the lesson topic in addition to oral discussion or lecture. It includes such activities as projection of transparencies, films, or slides, and the use of charts, models, mockups, simulators, and other training aids or devices. These activities are keyed to the related subject matter.

"Student Activity" Column. This column points out student activities which will help each student during the acquisition and application phases of the learning process. Activities listed lead directly to his achievement of the objectives and development of his ability to do practical work. Typical entries include the following:

6. Use the long range work goal listed in number 4 and complete the following format:

a. Long range goal:

b. Steps to accomplish goal:

Completion Date:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

7. What does the quote, "If you don't know where you're going, you'll probably end up somewhere else," mean?

## O. LESSON PLAN: JOB PREFERENCE AND SUITABILITY

**Unit Objective:** To explore the ramifications of job/career preference and suitability as prerequisite personal knowledge that impacts on job-seeking decisions.

**Performance Objective:** At the completion of this unit the student will be able to:

- Complete a weekly budget and determine minimum wages needed using an established budget format.
- Complete, in writing, a job acceptance criteria form.

**Skills Emphasized:**

- Understanding the concept of job preference and suitability.
- Calculating weekly expenses.

**Materials and Equipment:**

- Weekly budget forms
- Job acceptance criteria sheets

**Activities:**

1. Budget — Each student completes a weekly budget form and determines minimum wages needed to maintain this budget.
2. Job Acceptance Criteria — Each student completes a job acceptance criteria form to determine job preferences.

Hints for use of the Student's Guide; general and specific directions for classroom, laboratory or workshop time; notes emphasizing observance of personnel and equipment safety precautions; and security procedures which must be followed.

Modification or Revision. The teaching directions given in the Instructor and Student Activity columns reflect the best judgment of the writers as to the most effective teaching procedures. They should normally be followed as written. Should you prefer techniques or aids not listed in the Instructor Activity column, you are free to use them, subject to your supervisor's approval, provided that the topic objectives are achieved. Caution is advised in making changes before you have taught the lesson more than once. You are expected to add your personal teaching directions to those contained herein, particularly in the "Introduction," "Presentation," "Summary," and "Informal Test" areas.

You should submit your personal Lesson Topic Guide to your supervisor for approval prior to teaching the lessons for the first time.

If your experience in teaching the lesson later convinces you that changes or additions are desirable, consult with the education specialist or learning evaluator and submit your recommendations to the CDM via the appropriate channels.

Evaluation of Student Performance. Student progress will be evaluated by means of performance-based, criterion-referenced tests. Performance tests will range from informal application in the lab, guided by a Job Sheet, to formal Performance Tests also guided by Instruction Sheets. Appropriate tests for the objectives of each topic are specified in lesson outline.

Numerical grades will not be assigned. Each student will be given a final mark of SAT or UNSAT, depending upon whether he achieved each end-of-course and topic objective. To facilitate recording the student's progress, it is suggested that a locally prepared "Objective Achievement Summary Sheet" be maintained for each student.

CNT INSTRUCTION 1540.2 provides detailed guidance concerning criterion testing.

# ACTIVITY 2: WEEKLY BUDGET

Student's Name \_\_\_\_\_

Estimate of Weekly Living Expenses

	SUN	MON	TUES	WED	THURS	FRI	SAT	WEEKLY TOTAL
Food and Beverages At Home								
Food and Beverages Away From Home								
Household Costs Operations (e. g. utilities)								
Maintenance								
Laundry, Dry Cleaning								
Transportation Trains, buses, Private Car Operations								
Transportation Private Car Maintenance								
Recreation, Entertainment								
Clothing								
Routine Medical								
Personal Allowances (Magazines, books, records, movies, gifts, snacks, incidentals, etc.)								
Other Weekly Expenses								
<b>TOTAL</b>								



FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

HOMEWORK - NONE

Lesson Topic 1.2  
Introduction to the Course

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 1.0 Hour  
Laboratory - 0.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

a. MERP/2M Kit

2. Text

a. Student's Guide

TERMINAL OBJECTIVES

Supported entirely by this lesson topic: NONE

ENABLING OBJECTIVE

- 1.2.1 COMPLY with classroom procedures, regulations  
schedules, scholastic requirements and special  
instructional activities in accordance with  
information outlined in Student's Guide.

CRITERION TEST

The students will be tested by their compliance with  
course policies and assignments.



**Materials and Equipment:**

- Newspapers
- Industrial Directory
- Telephone books and telephones
- Paper and pencils
- Personal contact lists
- "How To Create A Job" sheets
- Company contact lists
- Job resources quiz
- "Let's Use the Want Ads"

**Activities:**

1. Quiz - This eight question quiz is used to evaluate the student's knowledge of various resources for employment and other aids in the job-search.
2. Creating a Job - Each student must read and complete the sheet on creating a position for yourself.
3. Personal Contact List - Each student must fill in the personal contact list that will provide possible job opportunities or connections.
4. Company Contacts - Each student will fill out a form of companies he/she would like to work for as another possible resource in the job-search. Also, each student will fill out a form of companies he/she may have skills for as yet another employment resource.
5. Yellow Pages - Students will practice using the yellow pages as a source of unlisted employment.
6. Chamber of Commerce - Students learn the importance and value of the Chamber of Commerce as a source of information in a job-search.
7. Vocabulary - Students will become familiar with want ad terminology for easier understanding.
8. Want Ads - Students will use the want ads to determine job openings and personal suitability as well as a means of using the communications techniques learned to respond to the ads.
9. Letters - Students will draft and send letters according to the prescribed form in reply to newspaper ads.
10. Employment Agency Contracts - Students will become familiar with contracts used by employment agencies in aiding your job-search.
11. Telephone Dialogue - Students will practice using the prompter and learn the proper dialogue to be used with personal contacts.
12. Library - Students will learn the value of the library as a source of information in the job-search.

OUTLINE OF INSTRUCTION

C. Effect

INSTRUCTOR ACTIVITY

2. The necessity of the skills and techniques in repair of printed circuit boards.

3. Personal applications of the knowledge and skills. Seek to motivate. Tell a good tie-in story if possible.

C. When following a subject matter lesson topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).

2. Commend students for mastery of skills in previous lesson(s).

STUDENT ACTIVITY

47

58



OUTLINE OF INSTRUCTION

D. Overview

INSTRUCTOR ACTIVITY

D. Overview lesson by:

1. Stating learning objectives as contained on cover page to this topic.
2. Stating procedures to be followed during the lesson.
  - a. Taking notes
  - b. Asking questions
  - c. Use of criterion test

STUDENT ACTIVITY

### How To Create A Position For Yourself

Student's Name \_\_\_\_\_

Date \_\_\_\_\_

Write a scenario depicting a person who has created a job for himself. (Use process presented in class).

## OUTLINE OF INSTRUCTION

## INSTRUCTOR ACTIVITY

## STUDENT ACTIVITY

bh

### II. PRESENTATION

#### A. Purpose of the course

1. To provide maintenance personnel with the latest methods to disassemble, repair and solder miniature printed circuits, components, terminals, solderable connectors, circuit board laminates and conductors to replace electronic components on microminiature single and double sided printed circuit boards and the proper preventive maintenance procedures for the repair station and its associated components.

#### B. Course Terminal Objectives

3. Invite questions concerning objectives and procedures.

#### A. Give a brief overview of the course

3. Ask questions concerning objectives or procedures if in doubt.

#### A. Student take notes and ask questions.

#### B. Review the Terminal Objectives to be achieved

62



OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

1. Replace component parts on printed circuit boards using the correct tools and soldering techniques and apply the proper conformal coating in accordance with the procedures and to the standards outlined in MIL-STD-454D and MIL-C-47256 (MI).
2. Remove conformal coatings from printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.
3. Remove printed circuit components parts using the correct tools and desoldering techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.

OUTLINE OF INSTRUCTION

4. Repair damaged printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in MIL-STD-454D.
5. Connect wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connected pins using the proper tools and soldering techniques following the procedures and to the standard outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4 (3A).
6. Replace component parts on micro-electronic printed circuit boards using the correct tools and soldering techniques and apply the proper conformal coating in accordance with the procedures and to the standard outlined in MIL-STD-454D.

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

51

12672-73P8

1-2-7

60

65

OUTLINE OF INSTRUCTION

7. Remove conformal coating from micro-electronic printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in Volume 6 of PACE Rework and Repair Technology Series.
8. Remove micro-electronic printed circuit board component parts using the correct tools and desoldering techniques following the procedures and to the standard outlined in Volume 6 of the PACE Rework and Repair Technology Series.
9. PERFORM preventive maintenance on the 2M Repair Station following the procedures and to the standards outlined in the applicable technical manual.

C. Reasons for the course

INSTRUCTOR ACTIVITY

C. Pass around to class circuit boards repaired in fleet with UNSAT work and damage to boards.

STUDENT ACTIVITY

C. Inspect boards and look for damage.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<ol style="list-style-type: none"><li>1. Despite component reliability 1,000 times better than in the past, circuit density has increased 100,000 times. Consequently we have an ever increasing number of component failures to deal with.</li><li>2. Even with the increasing failure rate, approximately 80% of the failures occurring today happen to assemblies which have been previously repaired. This shows that during some part of the repair cycle the assembly is being damaged or degraded in some manner.</li><li>3. A large part of the damage and degradation can be traced to a lack of correct training and equipment. Because of this lack, most technicians are causing serious degradation to the assemblies they repair, resulting in an increased failure rate and a much shorter assembly lifetime.</li><li>4. Before today's highly sophisticated electronic systems were developed, the soldering program, at both the manufacturing end and in repair, was quite lax.</li></ol>		79

### OUTLINE OF INSTRUCTION

5. Thus, to achieve a repair reliability in keeping with modern component reliability, this course was devised to teach you, the repair technician, the latest and best high-reliability repair techniques.

### E. Course Schedule

1. First week: Printed Circuit Maintenance
2. Second week: Terminals and Connector Pins
3. Third week: Micro-miniature Printed Circuit Soldering

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

71

99577-78P8

1-2-11

Note: Section D and F have been omitted because of military specific materials.

OUTLINE OF INSTRUCTION

## G. Safety

## 1. Personal

- a. Handle and store heat tools properly to avoid burns
- b. Handle and store pointed and edged tools properly to avoid cuts
- c. Be extremely careful of rotary tools, particularly when using cutting bits.

INSTRUCTOR ACTIVITY

- G. Stress safety points and ensure they comprehend.

STUDENT ACTIVITY

55

Student's Name \_\_\_\_\_

### ACTIVITY 5: COMPANIES WHO MIGHT NEED MY SKILLS

[illegible]

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
d. When using rotary tools always use eye protective goggles.		
e. Avoid prolonged skin or breathing contact of all chemicals used in the course.		
f. Avoid all eye, mouth, and open cut contact with chemicals used in the course.		
g. Do not breathe dust particles from cutting and grinding operations.		
h. Avoid any possibility of igniting flammable chemicals or materials.	1-2-15	

99577-78P8



After having completed a Legal Secretarial Science Course, Beth found that even with her newly attained skills, many law businesses desired experienced workers. Beth wanted more leads and more exposure than she received in the daily newspaper ads. If Beth used the telephone directory, what would be some headings she could look under?

---

---

---

List 6 places Beth could call.

---

---

---

Write out the dialogue Beth should use in her Yellow page search.

---

---

---

(X)

7.)

### OUTLINE OF INSTRUCTION

- i. Teflon releases toxic fumes at 400 degrees F. Be especially careful when thermally stripping wire as the element exceeds 400 degrees F and will cause fuming of Teflon insulation.

- j. Use common electrical safety to avoid shocks.

- k. Do not heat solvents. Some solvents release toxic fumes when heated. (For example, Chlorine and Phosgene gas)

### 2. Equipment

- a. Never perform any action on the workpiece that will cause damage or degradation.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

57

78

**ACTIVITY 7A: LET'S USE THE INDUSTRIAL GUIDE**

Upon calling (or going to) the Chamber of Commerce of Reading and Berks County, you discover that it can provide you with an Industrial Guide, a source of valuable information on local industries, that can prove helpful in your job search. How can you use the Industrial Guide?

---

---

---

List at least four things you can learn about an industry through this source.

---

---

---

Identify three companies you can call on for employment?

---

---

---

Why did you select the above three employers?

---

---

---

Write out the dialogue you will use with the employers?

---

---

---

---

---

### OUTLINE OF INSTRUCTION

- b. Handle all work pieces as though extremely fragile.
- c. Maintain cleanliness at all times.
- d. NEVER put enough strain on rotary tools to make them load down or bind.
- e. NEVER drop or bang an electrical power tool.
- f. Check all electrical cords for damage from hot tools, solvents or abrasion.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

1-2-17

99585-86P8

If you decided, after you knew where the company is located, that you'd like to apply for the job, who would you ask to speak to when you call the number given in the ad?

---



---

What job would you say you are applying for?

---

[ ]  
**MEDICAL SECRETARY** — Regular, part-time person required with occasional full-time responsibilities, & future long-term full-time potential. Busy doctor office. Graduated salary & benefits. Send resume, with refs., to Box 648 Eagle-Times.

[ ]

The ad above requests a resume complete with references. Draft the letter you would sent to accompany your resume (use separate page).

---



---

[ ]  
**ASSISTANT MEDIA BUYER TRAINEE** — Good typing skills a must — 60-70 wpm. head for figures, well organized, meticulous attention to detail. Opportunity for significant advancement with Berks County based 4A Advertising Agency serving regional and national clients. Reply to Box 858 Eagle Times.

[ ]

The article above states that the position requires 60-70 words per minute in typing. You feel that you could perform the duties well except you type 45 words per minute. Would it be wise to reply anyway? *Why? or Why Not?*

---



---



---



---

### OUTLINE OF INSTRUCTION

g. Properly clean all tools and store in the proper place.

h. Use each tool only in the manner for which it was designed to be used.

H. Work Station Inventory

a. Instructor will point out all tools and materials in the workstation.

### III. APPLICATION

A. Tool inventory

### INSTRUCTOR ACTIVITY

H. Instructor will point out each item in work station for inventory.

III. Point out each tool in work station.

### STUDENT ACTIVITY

H. Student will make a note if any item not in station and have instructor replace any broken tools.

III. Inventory tools. Ask questions if procedures are not clear.

59

82

[ ]  
**DATA ENTRY OPERATOR** — Key to disk.  
 Applications are now being accepted for the  
 position of Data Entry Operators. Exp. in key-  
 punch, Key tape necessary. Apply in person  
 Mid-Atlantic Distribution Center, F. W. Woolworth  
 Co., R.D. 3, Weaver Rd., Denver, Pa. Equal  
 Opportunity Employer.  
 [ ]

You have just completed your Data Entry course and as yet have no actual work experience  
 in the field. Would it be beneficial to apply for the job above even though it asks for  
 experience? Why? or Why not? \_\_\_\_\_

---



---

Write out the dialogue you would use in response to this ad. \_\_\_\_\_

---



---



---



---



---



---



---

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

IV. SUMMARY

A. Introduction

A. Emphasize importance of the summary for the student.

1. Nature of summary

2. Purpose of summary

B. Directions to students

1. Questions

2. Notes



**FUTURE:** Shows there is a chance to get promotions with the company.

**GOOD REFERENCES:** You must be able to give the names of reliable people who will speak well of you.

**HELPER:** One who helps on a particular job.

**HOURLY RATES:** The money you will receive for an hour's work; or, you will be paid by the hour.

**INTERVIEW:** A personal meeting with an employer.

**LABORER:** A person who works with his or her hands.

**MANAGER:** A person who directs or handles the affairs of a business.

**MINOR:** A person who is under 18 years of age.

**OPENINGS:** There are jobs available for which you can apply.

**OWN TRANSPORTATION:** You must have your own car.

**PART TIME:** To work only part of the working day, weekends, or after school.

**PERMANENT:** A full-time job that will not end after a certain period of time.

**PERSONNEL MANAGER:** The person in a company who is responsible for hiring people.

**RECEPTIONIST:** A person who sits at a desk and greets people who enter an office.

**REGISTER:** To apply for a job.

**RELIABLE:** A person who can be counted on and trusted.

**SALARY:** The money you get paid for working.

**SALARY OPEN:** The salary will be agreed upon between the employee and the employer.

**SALARY PLUS BONUS:** In addition to a regular salary, an extra sum of money will be given, depending on how the person works.

**SOLICITOR:** A person who sells something by telephone or goes from door to door.

**STEADY ADVANCEMENT:** As a person's work gets better, the person will be promoted.

**TEMPORARY:** A job that is only for a certain period of time.

OUTLINE OF INSTRUCTION

C. Recap of lesson

V. INFORMAL TEST - NONE

VI. ASSIGNMENT - NONE

INSTRUCTOR ACTIVITY

C. Emphasize safety and review policies if necessary.

STUDENT ACTIVITY

C. Ask questions if material not clear. Check notes to insure accuracy and completeness

19

86

85

Drv. Lic.: Driver's License.

EOE: Equal Opportunity Employer.

Equip.: Equipment.

Evs.: Evenings.

Exc. or Excell.: Excellent.

Exp. or Exper.: Experience.

Flex. Hrs.: Flexible hours.

Gd. Sal.: Good Salary.

Hr.: Hour or hours.

Incl.: Included.

Indiv.: Individual.

Info.: Information.

Lt.: Light.

Loc.: Location.

M/F: Male or female — the job is open to either.

Mech.: Mechanical.

M-F: Monday through Friday.

Min.: Minimum.

Mgr.: Manager.

Mkt.: Market.

Mo.: Month.

Nec.: Necessary.

Natl.: National.

Ofc.: Office.

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

Lesson Topic 1.3  
Introduction to High Reliability Soldering

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 2.0 Hours  
Laboratory - 0.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment - NONE
2. Training Aids
  - a. Slides YXH-L2-S3A thru YXH-L2-S15A
3. Training Aids Equipment
  - a. Projector, Slide
  - b. Screen, Projection, Standard
4. Text
  - a. Student's Guide

5. References

- a. MIL-STD-454D
- b. NHB-5300.4 (3A)
- c. NASA SP-5002

TERMINAL OBJECTIVE

Supported partially by this lesson topic:

- 1.0 REPLACE component parts on printed circuit boards using the correct tools and soldering techniques and APPLY the proper conformal coating in accordance with the procedures and to the standards outlined in MIL-STD-454D and MIL-C-47256 (M.I.).

ENABLING OBJECTIVES

When you complete this lesson topic, you will be able to:

- 1.3.1 IDENTIFY the characteristics of high reliability solder connections which include soldered area, solder quantity, solder finish, wetting and solder defects. Identification will be complete agreement with the information contained in MIL-STD-454D and NHB 5300.4 (3A).

87

9169-70P1

1-3-1

88

89

# ACTIVITY 10: NEWSPAPER ADVERTISEMENT REPLY LETTER FORMAT

In replying to newspaper advertisements, it is important that you immediately point out how your qualifications meet those requested in the advertisement.

Note: It's a good idea to delay your response a day. Hopefully, your letter will be received after the general replies.

---

Your address  
City, State, Zip Code  
Date of Letter

To Whom It May Concern:

Your advertisement for a \_\_\_\_\_ in the (Newspaper and date) appealed to me because it appears to be seeking someone with my qualifications.

Your requirements:

good typing skills

\_\_\_\_\_

\_\_\_\_\_

My qualifications:

type 60 WPM with 2 errors

\_\_\_\_\_

\_\_\_\_\_

Enclosed is a copy of my resume which further outlines some of my background.

I would like to meet with you to discuss my qualifications in more detail.

Sincerely,

Your name

Enclosure

- 1.3.2 OBSERVE all applicable equipment and personnel safety precautions, throughout the entire course of instruction, in accordance with the safety outlined in NASA Handbook SP-5002.

### CRITERION TEST

Satisfactory completion of Enabling Objective 1.3.1 requires the student to answer the written study questions in Assignment Sheet 1-3-3A correctly.

Strict observance of all safety precautions throughout the course is required for satisfactory completion of Enabling Objective 1.3.2.

### HOMEWORK

Read and study Notetaking Sheet 1-3-1N and complete Assignment Sheet 1-3-1A.

OUTLINE OF INSTRUCTION

I. INTRODUCTION

A. Contact

INSTRUCTOR ACTIVITY

A. Introduce self and topic.  
Provide for students needs:

1. Muster
2. Comfort
3. Visibility and seating.

STUDENT ACTIVITY

## ACTIVITY 13: LET'S USE THE LIBRARY

Upon completing his courses at RACC, Ryan found that he needed to explore the job market for opportunities. He is not certain whether he will stay in the Reading area or if he'd like to explore job opportunities in other cities. In addition to finding job openings, he'd like to learn more about various companies. If Ryan (or imagine yourself in this situation) were directed to the Public Library, he would find newspapers, telephone directories, annual reports, reference services, Dun and Bradstreet, (Books, reference books), magazine articles, pamphlets, and non-print materials (i.e. films) How can each of these sources prove helpful to Ryan?

Newspapers \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Telephone directories \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Annual Report \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reference services \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Dun & Bradstreet \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



## F. LESSON PLAN: PRE-APPLICATION SKILLS

**Unit Objective:** To recognize the sequenced progression of, and the devices (resumes, etc.) used in, the application process for the purpose of rehearsing the skills and refining the products used in the process.

**Performance Objective:** At the completion of this unit the student will be able to:

- Complete designated format for employment history correctly.
- Complete personal data, job accomplishments, and employment objective format correctly.
- Draft a resume using format designated in class.
- Draft an introductory cover letter to accompany resumes using guidelines provided in class.
- Draft letter(s) to person(s) to be used as references to secure permission to use their name(s).
- Draft a follow-up letter to respond to newspaper ads using format provided in class.
- Complete a written quiz on the use of resumes, introductory letters, follow-up letters, want ad letters, and reference letters with 80% proficiency.
- Provide instructions for typing and reproduction of resumes and letters drafted to be used in job search.
- Prepare and complete a log to be used to monitor activities during the entire job search.
- Complete a written quiz on job application completion with a proficiency rate of 80%.
- List three options available for completion of salary blank on employment application.
- State one advantage and one disadvantage of not indicating salary on applications.
- Complete a written quiz on interview preparation with 80% proficiency.
- Respond orally to twenty questions most frequently asked during an interview.
- Complete the task on the job pre-interview checklist before the mock interview.
- Give written examples of five things not to do at an interview. Also, provide a reason why not.
- List at least five questions the interviewee should ask at an interview.
- Demonstrate in a mock interview, skills listed on the interview checklist.
- Express at least two suggestions for improving the mock interview session.
- Paraphrase the statement, "Oress for the job you are seeking."

OUTLINE OF INSTRUCTION

D. Overview

INSTRUCTOR ACTIVITY

D. Overview lesson by:

1. Stating learning objectives as contained on cover pages to this topic.
2. Stating procedures to be followed during the lesson.
  - a. Taking notes.
  - b. Asking questions.

STUDENT ACTIVITY

69

98

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
	c. Use of criterion test.	
	3. Invite questions concerning objectives and procedures.	3. Ask questions concerning objectives or procedures if in doubt.
<p>II. <u>PRESENTATION</u></p> <p>A. Characteristics of solder and soldering bonding.</p> <p>1. Analysis of solder composition</p>	<p>A. Explain and describe the characteristics while projecting the appropriate slides. Refer students to Notetaking Sheet 1-3-1N.</p>	<p>A. Follow lesson using the Notetaking Sheet 1-3-1N as directed. Ask questions when necessary.</p>

OUTLINE OF INSTRUCTION

a. Solder - metal alloy consisting of two or more metals used in various percentages to form the solder alloy.

b. Various elements make up solder.

(1) Tin - Sn

(2) Lead - Pb

(3) Silver - Ag

INSTRUCTOR ACTIVITY

b. Show slide YXH-L2-S3

STUDENT ACTIVITY

69

101

101

9171-72P1

1-3-8

## ACTIVITY 3: RESUME FORMAT

Rhonda Smith  
610 North 12th St.  
Reading, Pa 19601  
(215) 775-1021

**POSITION OBJECTIVE:** Full Time Secretarial Position

**BACKGROUND SUMMARY:** Successful secretarial experience includes: Mag Card II use, transcribing, conference coordination, organizing business trips, implementing new file systems, drafting letters, coordinating staff of 35, monitoring time sheets, making travel arrangements.

## WORK ACCOMPLISHMENTS

**FILE ORGANIZATIONS** Purged 10 year old files and established new file system.

**COORDINATION OF STAFF** Manager on one month business trip, I coordinated correspondence, time sheets, telephone requests and other staff needs.

**TRANSCRIBING** Took notes at all staff meetings and board meetings. Responsible for editing and sending copies of minutes to President of Company.

**EMPLOYMENT HISTORY:** Secretary. Hartford Insurance Group, 412 Washington Street, Reading, PA. Responsible for all clerical and coordination functions for staff of 35.  
(June 1977 to Present)

Clerical Typist II. Metropolitan Property & Liability Insurance Company. 500 Penn Street, Reading, Pa. Responsible for all typing, telephone answering and filing.  
(January 1971 - June 1977)

<b>EDUCATION/ TRAINING</b>	Roosevelt High School	RACC/TRAC
	Reading, PA 19607	Reading, PA 19603
	Business Course 1967-70	Work Readiness Course
	Diploma Received	1970-71
		Certificate Received

<b>PERSONAL:</b>	Date of Birth: 6-12-52	Health Status: Excellent
	Marital Status: Married	Language: Spanish

**REFERENCES:** Will be furnished upon request.

OUTLINE OF INSTRUCTION

(4) Antimony - Sb

(5) Bismuth - Bi

(6) Copper - Cu

c. Bismuth and Antimony added in small percentages for special purpose applications.

d. Copper added to solder to saturate the alloy with copper molecules slowing down the solder solvent action on soldering iron tips.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

100

70

## ACTIVITY 4: RESUME PREPARATION

The best policy for resume preparation is the KISS Method (Keep It Simple Stupid). No Offense!

The goal of a resume is to present a one page highlight of your accomplishments.

We will complete the resume by compiling several formats.

EMPLOYMENT HISTORY FORMAT

(Please Complete)

Job Title: \_\_\_\_\_

Employer's Name & Address: \_\_\_\_\_

From: \_\_\_\_\_

To: \_\_\_\_\_

Duties: \_\_\_\_\_

What did you do in this job that you were most proud of?: \_\_\_\_\_

Job Title: \_\_\_\_\_

Employer's Name & Address: \_\_\_\_\_

From: \_\_\_\_\_

To: \_\_\_\_\_

Duties: \_\_\_\_\_

What did you do in this job that you were most proud of?: \_\_\_\_\_

OUTLINE OF INSTRUCTION

e. Silver added to solder to slow down the solder washing on silver plated nonsolderable surfaces.

f. Solder commonly used - alloy of tin and lead without special additives.

(1) Most common alloys are 60/40 and 63/37.

(2) Tin lead solder alloy - tin content percentage listed first.

INSTRUCTOR ACTIVITY.

STUDENT ACTIVITY

71

104

105



From: \_\_\_\_\_

To: \_\_\_\_\_

Name of School: \_\_\_\_\_

Address of School: \_\_\_\_\_

Type of Courses Taken: \_\_\_\_\_

From: \_\_\_\_\_

To: \_\_\_\_\_

Name of School: \_\_\_\_\_

Address of School: \_\_\_\_\_

Type of Courses Taken: \_\_\_\_\_

From: \_\_\_\_\_

To: \_\_\_\_\_

Name of School: \_\_\_\_\_

Address of School: \_\_\_\_\_

Type of Courses Taken: \_\_\_\_\_

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>2. Effects of heating and cooling solder</p> <p>a. Tin/lead solder alloys versus temperature.</p> <p>(1) At 361 degrees F, all solders from a range of 15/85 to 95/5 change from a solid to a plastic state except one.</p> <p>(2) Alloys with a single sharp melting point which change directly from a solid to a liquid with no plastic state is called an EUTECTIC alloy. 63/37 solder is known as EUTECTIC solder.</p>	<p>a. Show slide YXH-L2-S4</p>	

## ACTIVITY 6: REFERENCE PERMISSION LETTER

The objective of a "reference permission letter" is to get permission to use someone's name as a job reference.

When choosing people whom you want as references, consider those who have worked with you over a period of time, especially your supervisors. Also consider people from your "personal contact list," especially professionals such as civic leaders; or socially prominent leaders in your community, but exclude credit references.

Also, include your resume with the reference permission letter.

For your own security send a self addressed, pre-paid postal card with your letter of reference permission. The return of the postal card to you will let you know the person is willing to give you a positive reference if contacted by an employer.

### Reference Permission Letter Format

Your address  
City, State, Zip Code  
Date of Letter

Name of Reference  
Address  
City, State, Zip Code

Dear \_\_\_\_\_:

Currently, I am involved in a job search. I am seeking a \_\_\_\_\_ position.

I would like to have your permission to use your name as a reference. I am enclosing a self addressed postal card for your response.

Your cooperation will be appreciated.

Sincerely,

Your Name

Enclosure

117

### OUTLINE OF INSTRUCTION

(3) Different alloys reach full liquid state at different temperatures.

b. As solder is heated, it passes from a solid state through a plastic and into a liquid state, with the exception of the eutectic point at which there is no plastic state.

c. Most critical area-time-temperature range - solder is in a plastic state.

(1) Plastic state - combination of liquid tin/lead alloy with solid pure metal crystals - either tin or lead.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

73

108

109

## ACTIVITY 7: FOLLOW-UP LETTER

The follow-up letter is a courtesy that just might get you the job. The objective is to thank the employer and reinforce your interest in the position.

You can follow-up the letter with a call.

Consider the following dialogue . . .

"Mr. or Ms. (Employment Manager's name or Interviewer's name),

This is (Your Name). I had an interview with you last (day or date), and I thought I would call to see how things are coming along."

## Follow-up Letter

Your address  
City, State, Zip Code  
Date of Letter

Name of Interviewer  
Title  
Name of Company  
Address  
City, State, Zip Code

Dear \_\_\_\_\_:

Thank you for the opportunity to interview for the name of position position.

I am very interested in the position and feel confident that I will be able to perform the duties outlined.

I look forward to hearing from you very soon.

Sincerely,

Your Name

OUTLINE OF INSTRUCTION

- (2) Eutectic point will determine whether the crystals are pure lead or pure tin.
- (3) Lead-rich relation to eutectic point, crystalline structure pure lead.
- (4) Tin-rich relation to eutectic point, crystalline structure pure tin.
- (5) Any physical movement of solder, while cooling through plastic state, will permanently damage intermolecular crystalline structure solder alloy, resulting in fractured solder connection.

INSTRUCTOR ACTIVITY

- (5) STRESS this point...

STUDENT ACTIVITY

15. Can you get recommendation from your former employer?
16. What have you learned from some of the jobs you held?
17. What were your duties?
18. How many time were you late on your last job?
19. How did your last boss rate you at evaluation time?
20. Have you ever been fired?

#### AMBITION AND PLANS

21. What do you feel are your greatest strengths?
22. Are you a joiner or a loner? A leader or a follower? A committee member or an executive?
23. What job in our company would you choose if your were entirely free to do so?
24. What do you hope to be doing ten years from now?
25. How long do you expect to work?
26. How old were you when you became self-supporting?
27. Will you fight to get ahead?
28. What does success mean to you? How do you judge it?

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

75

- (6) 60/40 solder - highly acceptable for electronic soldering - has advantage of forming slightly stronger joint than 63/37 solder. 60/40 solder disadvantage - plastic range is from 361 to 370 degrees F - change of fractured solder connections.

3. Soldering flux -

a. Soldering flux types

(1) Chloride (ACID)

(2) Organic

113.

112



**PERSONAL AND SHOCKERS**

42. How does your husband/wife feel about your work (career, profession)?
43. Have you been married before?
44. What arrangements will you make for your children?
45. Are you busy this evening?
46. Have you ever been treated for mental illness?
47. What do people think about you?
48. What do you find to criticize about others?
49. Can you take instruction without feeling upset?
50. Have you ever used drugs? How much do you drink?
51. Do you have any hobbies?
52. How do you spend your spare time?
53. What kind of people do you enjoy working with?
54. Tell me about your weaknesses?

NOTE: Some of these are routine; some are impertinent and are designed for shock value. Plan how to respond to them in terms of your own values (Courteously).

OUTLINE OF INSTRUCTION

(3) Rosin/resin

b. Purpose - remove surface oxides

(1) All metals oxidize when exposed to air

(2) Oxidation causes thin film of nonmetallic oxide to form on metal surface

(3) Oxide film prevents metal-to-metal contact necessary for soldering

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

115

96

**ACTIVITY 9: DON'TS OF INTERVIEWING**

- Don't be a comedian.
- Don't exaggerate.
- Don't take over the conversation.
- Don't try to hide anything.
- Don't interrupt.
- Don't stall.
- Don't be too hasty.
- Don't overdo or brag.
- Don't softsoap.
- Don't be too technical (unless requested).
- Don't be evasive.
- Don't try to give the answer you think the interviewer wants.
- Don't make negative comments about previous bosses or employers (employment managers react negatively to those kinds of comments).
- Don't presume the question — let the interviewer finish the question before you answer it.
- Don't wear sunglasses in the interview.

OUTLINE OF INSTRUCTION

- (4) Flux chemically breaks down surface oxides loosening film

c. Flux characteristics

- (1) Chloride fluxes are inorganic salts - most active of fluxes. Effective on all common metals except aluminum and magnesium. Not suitable for reliable electronic soldering - highly corrosive - electrically conductive.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

77

117

116

9173-74P1

1-3-16

**PERSONNEL**

13. Who would I be working with? How many are there? My immediate supervisor? Associates in related departments?
14. Could you describe the atmosphere (feeling, tone) of the department? How do the people relate to one another? Do they tend to form personal relationships?
15. Do you have suggestions about becoming integrated into the department?
16. What problems do you feel I will have adjusting to this position?

**THE DEPARTMENT**

17. Does the company have any long range plans for this department?
18. What new projects or ventures are contemplated in the near future?
19. How long has this department existed?
20. Where does this department fit in the company's organizational plan?
21. Is there more than one boss?
22. Who makes the final decision on hiring for this position?

**ORIENTATION AND/OR TRAINING**

23. Is there a training program or orientation program for new employees?
24. How can I become familiar with company policies and etiquette?

OUTLINE OF INSTRUCTION

- (2) Organic fluxes - nearly as active as inorganic fluxes - less corrosive - easier to remove - must be completely removed to prevent corrosion - extremely short lifetime at high temperatures.
- (3) Rosin flux - ideally suited electronic soldering. Molecular structure inert at normal temperatures, breaks down and highly active at soldering temperatures. Totally noncorrosive except at soldering temperatures. Non-conducting, having  $3.3 \times 10^{15}$  (3,300 trillion) ohms per cubic inch resistivity.

118

9175-76P1

INSTRUCTOR ACTIVITY

1-3-17

STUDENT ACTIVITY

119

78

37. How do you feel about hiring somebody who has been in jail?
38. Does the company have any policy regarding membership in the Communist party?
39. How much money do you make?

### OUTLINE OF INSTRUCTION

d. Soldering flux aids forming intermetallic solder bond and improves wetting action.

(1) Lowers existing surface tension

(2) Wetting action aided by floating action of flux - loosened oxides carried away from solder path

e. Use of flux a NECESSITY

f. Flux available as external agent or intergral part of solder...

### INSTRUCTOR ACTIVITY

(1) Display slide YXH L2-S5

e. STRESS this point...

### STUDENT ACTIVITY

79



## ACTIVITY 12: DRESS FOR THE POSITION YOU WANT – MALE

Because we are judged by our appearances (In this case you *can* tell a book by its cover!), a good rule to follow is to dress for the position you want.

Remember these basic rules when job-seeking:

- Don't let a girlfriend or wife choose your clothing unless she is a wardrobe engineer!
- Don't be influenced by designer.
- Don't let your background (social, cultural, economic) choose your clothing.
- Don't overdo it — be conservative.

### SUITS

- Choose a suit wisely (don't be cheap) and have it well fitted.
- Buy wool or polyester and wool blend because they look better and last longer.
- Choose blues, grays, and beiges for your suit color. (Black suggests a funeral)
- Solid suits are best but pinstripes are fine as long as you choose wisely and avoid the "ganster look."
- Plaids are fine if they are subtle and businesslike.  
(Rule of thumb: If you can wear your plaid suit jacket separately as a sport jacket, don't buy it.)

### SHIRTS

- Shirts should be cotton or cotton and polyester blend. Unfortunately, cotton wrinkles terribly while wash-and-wear stays neat.
- Never wear shiny or see-through shirts.
- Choose shirts in solid, pale blue or other pastels.
- Avoid pink or lavender shirts — they have negative masculine associations (If you're black, these colors should be avoided because of prejudicial association).
- Never wear floral, paisley, or picture shirts for business.
- Long sleeves are better — they show more authority.
- No pockets on shirts is better but one plain pocket is fine.
- Never wear a shirt with pleats, ruffles, cowboy yokes, or flashy buttons.

OUTLINE OF INSTRUCTION

g. External agent flux applied by hand

(1) Range from thin liquid to heavy paste

(2) Paste fluxes contain Zinc Chloride as activating additive

(3) Fluxes containing Zinc Chloride should never be used in high reliability soldering - corrosive

h. Most electronics solder contain flux as integral part of solder

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1-3-19

80

## DRESS FOR THE POSITION YOU WANT — FEMALE

Frequently, people judge you by the way you dress. A rule of thumb would be to dress for the position you want, not the position you have. Consider the following when you are job-seeking:

Here are four basic rules to follow:

- Don't let the fashion industry influence you — fads are out!
- Don't view yourself as a sex object — if you dress sexy, you're not selling your brain.
- Don't let your social economic background influence your choice of clothing.
- Don't dress in pinstriped pantsuite — don't be an "imitation man."

Now for some pointers that help you dress for success:

### DON'T:

- Wear knit polyester suits.
- Wear pants when dealing with men.
- Wear designer glasses.
- Wear vests with suits — it accentuates the bustline.
- Wear pinks, purples, or light greens — you want to look businesslike not girlish.
- Wear a lot of make-up — no eyeliner and little or no eye shadow and clear nail polish.
- Wear jewelry you'd wear at nighttime.

### DO:

- Dress like you are applying for the job one or two steps higher than the one for which you are interviewing.
- Wear a skirted suit (no vest) in wool, tweed, or linen.
- Wear these color suits: navy blue, gray, camel, dark maroon, beige, black with white, light blue or other contrasting color blouse.
- Wear skirt slightly below the knee.
- Wear upper-middle class clothing. (Cross-shop in most expensive shop and compare quality with shop in your price range. Once you've found quality item for more reasonable price, that's your choice.)
- Wear plain pumps — no high heels with open toe or heel.
- Wear neutral-colored pantyhose (skin colored).
- Carry an attache case, if possible, or a good leather purse.
- Shop carefully for greatest mileage — cheapness doesn't pay!

See J. T. Molloy's *The Woman's Dress For Success Book* for more information.

OUTLINE OF INSTRUCTION

- (1) Flux core,
- (2) Standard flux sizes specified in Federal Spec QQ-S-571E
- (3) Flux content measured in percentage by volume, for a given core type. Remains constant percentage regardless of solder gauge.
- i. External flux use with flux-core solder highly recommended
- j. External flux recommended in MIL-S-45743C

INSTRUCTOR ACTIVITY

- (1) Display Slide YXH-L2-S6
- (3) EMPHASIZE

STUDENT ACTIVITY

18

If person indicates there are no openings:

"May I call you back in two weeks to see if you have any openings?"

"Can you suggest another company that would have openings?"

"Thank you for your time and interest."

If you sent an introductory letter and resume to the employment manager, you might use the following dialogue:

"Good morning (afternoon) Mr. or Mrs. (employment manager's name).  
My name is ( ), and I recently sent you a letter and resume.  
My purpose in calling today is to see if I can arrange for an interview with  
you. I would like to discuss employment possibilities at (company name)  
in person with you."

If the person indicates there are no openings, ask the questions on future openings and other possible employers.

OUTLINE OF INSTRUCTION

(1) Kexter Solder Co. #1544 with  
#104 thinner

(2) Alpha Metals, #711 with #412  
thinner

k. Special forms and shapes of  
solder available

(1) Solder preforms apply  
precise amounts on  
repetitive basis.

INSTRUCTOR ACTIVITY

(1) Display slide  
YXH-L2-S7

STUDENT ACTIVITY

## ACTIVITY 15: PERSONAL DATA CARD

## FRONT

## REFERENCES

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_ Zip Code \_\_\_\_\_

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_ Zip Code \_\_\_\_\_

Name \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_ Zip Code \_\_\_\_\_

## WORK EXPERIENCE

Company \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

Supervisor's Name \_\_\_\_\_

How Long Employed \_\_\_\_\_

Company \_\_\_\_\_ Phone \_\_\_\_\_

Address \_\_\_\_\_

Supervisor's Name \_\_\_\_\_

How Long Employed \_\_\_\_\_

## BACK

## EDUCATION

Year

Grade School \_\_\_\_\_

High School \_\_\_\_\_

Voc. Training \_\_\_\_\_

Other Training \_\_\_\_\_

CARRY THIS CARD IN YOUR  
WALLET FOR QUICK REFERENCE**GODD LUCK!**

RACC/TRAC

## PERSONAL DATA

Father's Name \_\_\_\_\_

Mother's Name \_\_\_\_\_ Maiden \_\_\_\_\_

Address \_\_\_\_\_ Phone \_\_\_\_\_

Social Security No. \_\_\_\_\_

Date of Birth \_\_\_\_\_

**"YOU NEVER GET A  
SECOND CHANCE TO MAKE  
A FIRST IMPRESSION!"**

PERSONAL DATA CARDS -- This pocket-size card serves as a source of ready information vital to correctly and thoroughly completing application forms.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(2) Used in production when not accessible by hand (sealed cans).

(3) Special forms quite expensive - not normally needed

(4) Preforms available in flux-core and solid solder

1. Specifications for fluxes and flux-cored solders

(1) Federal Spec 0-F-506-B



## ACTIVITY 1: APPLICATION COMPLETION

Application forms offer job hunters a lot of frustration. They are important to employers and usually you will have to complete them before you get an interview. Keep the following tips in mind when you have to fill one out.

1. When you fill out an application, always type or print neatly, and try not to erase.
2. Never fill them out in an hurry, and always try to fill them out at home (if possible). If you aren't allowed to, come prepared with names, dates, etc., which will be required.
3. If the salary objective is requested on a form, you should generally leave it blank. Also, you can indicate "Negotiable", which means you are willing to discuss the salary.
4. If an application requests school or college grades and you were near the bottom of your class, be sure to emphasize part-time jobs or other activities while in school.
5. When filling in work experience sections, do not leave blanks, in other words, make sure you account for all the past years that you have or have not worked (use dates).
6. Always stress your *positive* points, without lying or exaggerating. Don't "overdo" the application or try to write *too much*.
7. References are very important — you'll usually need at least three. Be sure to spell names correctly; list their occupation or position; their address; and phone number.
8. Fill out the entire application. If you leave parts blank the application may be discarded.
9. Don't return your application by mail, go in person! The mail is less personal, slower, and there is no chance to talk to the people who may hire you.

Even though you may possess the skills necessary to get the job of your choice, it is a well-known fact that 75% of *all applicants* are "screened out" by employment application forms alone. If you do not have the ability to properly complete such a paper, you will invariably be among the 75% screened out.

No matter what method of job application, most large businesses and industrial concerns require applicants for positions to fill out application blanks. If you apply by letter, you may receive an application blank by mail with the request that you fill it out and return it.

OUTLINE OF INSTRUCTION

(2) MIL-S-6872A

(3) MIL-F-14256C-1

(4) MIL-F-20329A

4. Intermetallic bond and wetting  
action

a. Solder does not act as adhesive  
or glue

130

INSTRUCTOR ACTIVITY

4. Display slide  
YXH-L2-S8

1-3-23

STUDENT ACTIVITY

131

h8

## WORDS AND PHRASES TO KNOW

There are many words and phrases on an application blank. Some may be new to you. Here's what they mean:

**NAME:**                      **LAST**                      **FIRST**                      **MIDDLE**

Your last name is sometimes called "surname" and is your family name — like Molloy, Eldred, DeVore. Your first name is the name you were given by your parents — like John, Harold, or Charles. Your middle name is exactly that, the one in the middle — like John *Patrick* Molloy.

**PERMANENT ADDRESS:**

The place where you usually live.

**PREVIOUS ADDRESS:**

The last place you lived before you moved to your present address.

**MARITAL STATUS:**

Are you married?      Single?      Divorced?      Widowed?      Separated?

NOTE: You do not have to answer this question if you so choose.

**NOTIFY IN CASE OF EMERGENCY or NEXT OF KIN:**

Name and address and telephone number of someone your employer can call in case you get hurt or sick on the job. This is usually your husband, wife, or parent(s).

**SPOUSE'S NAME:**

Your spouse is your husband or wife.

**NO. OF DEPENDENTS:**

This question means how many other people depend on you to pay for their support.

**DISABILITIES or PHYSICAL DEFECTS:**

Any handicap or physical problem which might make it hard for you to do certain kinds of work, such as "trick knee" or "bad back". (If you have a disability, be sure you talk to a Vocations Rehabilitation Counselor about how to present this disability to an employer.)

OUTLINE OF INSTRUCTION

b. Solder forms intermetallic bond with solderable metals - NOT by fusion or welding.

c. Intermetallic bond formed is solvent or solution action.

(1) Plastic melts at high temperatures but will dissolve at room temperature when placed in solvent like acetone.

(2) Dissolving action forms intermetallic bond with solderable metals.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

85

**HAVE YOU EVER BEEN BONDED?**

Many employers ask you to be bonded, particularly if you are going to handle money. This means that the bonding company gives insurance, in a way, that you are honest. If you have been bonded in the past, it is in your favor. If you were not considered honest, the bonding company would not have taken a chance on you.

**PERSONAL REFERENCES:**

If you looked up and wrote down the names, addresses, and telephone numbers of three (3) people who know you and will speak well of you, now you copy these on the application blank. This saves time. You don't have to look up these names over and over again in the telephone book. (They are also on your Resume which you completed in Lesson Plan F; Activity 3. You should have a copy of your Resume with you at the time you fill out an application.)

**EMPLOYMENT RECORD:**

All the jobs you have had. Be sure to put down part-time jobs. Get this list together and write it down. (You did this in Lesson Plan E.) Then just copy it on the application form. You list your most recent job first, then work backwards from that. For each job, you will probably be asked to give some of the following information:

**FROM — TO:** Dates employed.

**KIND OF BUSINESS:** What kind of company you worked for.

**JOB TITLE:** Name of the job you had.

**DUTIES:** Usually there is not enough space to list your duties on your last job. Just put down what you did and keep it as short as possible.

**SALARY: START — END:** What you earned when you began the job and what you were earning when you left the job.

**REASON FOR LEAVING:** This is very important. Sometimes reasons are long and complicated. So try to find a few words that sum up the situation such as "resigned", "temporary job", or "back to school". If you were fired, you can say "left with the agreement of the employer".

**COMPENSATION CLAIM:**

Did you ever get money for an injury you got on-the-job?

**GIVE DETAILS OR GIVE PARTICULARS:** Tell what happened, where, when, why, and how.

**POSITION DESIRED:**

Type of work you are applying for.

### OUTLINE OF INSTRUCTION

(3) Bond formed by solder is a completely new alloy (solder in solution with the metals being soldered).

(4) Connection a single complete piece of metal consisting of at least three separate alloys. (base metal, base metal and solder and solder)

d. Wetting Action - degree of ease and completeness solder spreads over surface of the metal being soldered.

e. Completeness of wetting action measured by tangent angle "dihedral angle of wetting"

### INSTRUCTOR ACTIVITY

d. EMPHASIZE

e. Draw wetting action angle on chalkboard.

### STUDENT ACTIVITY

## WHAT TO DO ABOUT A BAD RECORD

Many people get "into trouble" at some time in life — most of all when they are young. Maybe they don't do well in school and get poor marks. Maybe they get into trouble with the law. Maybe they do other foolish things they are sorry about later.

Maybe these things happened to you. Maybe they happened only once. Maybe they happened when you were very young. It is true that some employers might still hold these things against you. There are other employers who will try to understand and give you another chance. But remember, employers have ways of finding out.

If you have done better since you got into trouble, or if you plan to do better from now on, say so on your application blank. Your employer might see that you are honest and that you sincerely want to do a good job.

Remember — if you have a police record and do not admit it, the employer may find out later on. When that happens, you could lose your job.

If the offense was a juvenile offense, you may put a question mark (?) in that blank because you technically cannot be arrested for a juvenile offense and the blank does state "arrested" (Please see your communications instructor for assistance in answering these types of questions).

- | <u>OUTLINE OF INSTRUCTION</u>   | <u>INSTRUCTOR ACTIVITY</u> | <u>STUDENT ACTIVITY</u> |
|---|----------------------------|-------------------------|
| (1) Small angle indicates through complete wetting                                  |                            |                         |
| (2) Large angle formed by sphere or bubble indicates poor wetting                   |                            |                         |
| f. Wetting action is prime indication of quality and reliability of solder joint... |                            |                         |
| 5. Effect of metallic plating on solder joints                                      |                            |                         |
| a. Purpose  |                            |                         |



# APPLICATION FOR EMPLOYMENT

EASE PRINT PLAINLY)

Date \_\_\_\_\_

PERSONAL

Name \_\_\_\_\_ Social Security Number \_\_\_\_\_  
LAST FIRST MIDDLE

Present Address \_\_\_\_\_ Phone Number \_\_\_\_\_  
NO & STREET CITY STATE ZIP CODE

In case of emergency notify Name \_\_\_\_\_ Address \_\_\_\_\_ Phone No. \_\_\_\_\_

Height \_\_\_\_\_ Ft. \_\_\_\_\_ In. Hobbies \_\_\_\_\_

Weight \_\_\_\_\_ Lbs. Interests \_\_\_\_\_

JOB INTEREST

Position applied for \_\_\_\_\_ Pay Expected \$ \_\_\_\_\_

☐ Full time ☐ Part time nights ☐ Part time days SHIFT ☐ First ☐ Second ☐ Third

My available hours for part time work (Monday through Friday) are from \_\_\_\_\_ to \_\_\_\_\_

How were you referred to this company? ☐ Company employee ☐ Other (specify) \_\_\_\_\_  
☐ State employment office ☐ Newspaper ad (specify newspaper) \_\_\_\_\_

What factory or office equipment can you operate proficiently? \_\_\_\_\_

Ever applied to or been employed by this company? \_\_\_\_\_ If so, when? \_\_\_\_\_

Prior U.S. Government security clearance ☐ Yes ☐ No Level of clearance \_\_\_\_\_

Names of relatives employed by this company \_\_\_\_\_

EDUCATION

Type of School	Name and address of School	Courses Majored in	Graduate?	Date last attended
High School				
College				
Business or Trade School				
Corresp. or Night School				

MILITARY

Have you ever been in U.S. Military Service? \_\_\_\_\_

Date active duty started \_\_\_\_\_ 19\_\_\_\_ Branch of U.S. service \_\_\_\_\_

Was the discharge other than dishonorable? ☐ Yes ☐ No

HEALTH

Number of days lost from work during past 12 months because of illness \_\_\_\_\_ Do you wear Glasses? \_\_\_\_\_ Are you color-blind? \_\_\_\_\_ Are you right or left handed? \_\_\_\_\_

Have you ever applied for or received any state Workman's Compensation or Disability Payments? \_\_\_\_\_ If yes, Please explain \_\_\_\_\_

Have you been hospitalized in the past 6 months? \_\_\_\_\_ If yes, When? \_\_\_\_\_

MISC.

Have you ever been found guilty of a felony? \_\_\_\_\_ If yes, Date \_\_\_\_\_ For what? \_\_\_\_\_

Is your wife (husband) presently employed? \_\_\_\_\_ If yes, at what company \_\_\_\_\_ Wife (Husband's) first Name \_\_\_\_\_

Itek Corporation is an equal opportunity employer that does not discriminate because of age, color, creed, race, or sex

OUTLINE OF INSTRUCTION

(1) Protects metal - prevents oxidation

(a) Prevention of oxidation keeps base metal clean and highly solderable

( ) Gold one of best platings - lowest of electromotive series of elements. Quite porous, however, thus applied in relatively thick layer.

(2) Plating applied to component leads made of nonsolderable metal

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

139<sub>2</sub>

# EMPLOYMENT HISTORY

(RECORD U.S. MILITARY SERVICE AS A POSITION)

List below the names of all your former employers, beginning with the most recent: a. Employer's name b. Address	Kind of Business	Time Employed				Job Title and Duties	Starting Pay	Final Pay	Reasons for Leaving
		From		To					
		Mo.	Yr.	Mo.	Yr.				
1. a. _____ b. _____									
2. a. _____ b. _____									
3. a. _____ b. _____									
4. a. _____ b. _____									
5. a. _____ b. _____									
6. a. _____ b. _____									
7. a. _____ b. _____									
8. a. _____ b. _____									

Indicate by number \_\_\_\_\_ any of the above employers you do not wish us to contact.

This is just to advise you in accordance with Public Law 91-508 that in processing your application for employment we may request an investigative consumer report which may include information as to your character, general reputation, personal characteristics and mode of living. Upon written request by you within a reasonable time after you have received this notice, additional information as to the nature and scope of the report, if one is requested, will be provided to you.

I authorize investigation of all statements contained herein and understand that misrepresentation or omission of facts called for is cause for dismissal. I understand that any employment existing from this application does not imply any contractual relationship unless otherwise specifically agreed upon.

An applicant for employment with a stated record of arrest ten years old or over on file with the commissioner of probation may answer "no record" with respect to an inquiry herein relative to prior arrests or minor court appearances or convictions. An applicant for employment with a stated record on file with the commissioner of probation may answer "no record" to an inquiry herein relative to prior arrests or criminal court appearances.

**APPLICANT SHOULD NOT WRITE BELOW THIS LINE**

Date \_\_\_\_\_ Signature \_\_\_\_\_

Job Title _____	Grade _____	<b>REFERENCES</b> Give references (not former employers or relatives) May we contact these references? <input type="checkbox"/> Yes <input type="checkbox"/> No  a. Name _____ Street and Number _____ Occupation _____ City and State _____  b. Name _____ Street and Number _____ Occupation _____ City and State _____  c. Name _____ Street and Number _____ Occupation _____ City and State _____						
Rate _____	Dept. No. _____							
Starting Date _____	Clock No. _____							
Parking Space No. _____	Birth Date _____							
Reference Checks Made <table border="1"> <thead> <tr> <th>Company</th> <th>By Whom</th> <th>Date</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>		Company	By Whom	Date				
Company	By Whom	Date						

105

106

OUTLINE OF INSTRUCTION

(a) Nonsolderable metals used to obtain special strength, flexibility and thermal expansion characteristics

(b) Leads are plated with solderable metal

(c) Do not damage or remove plating from base metal

b. Effects of plating on inter-metallic bond

INSTRUCTOR ACTIVITY

(c) STRESS

b. Display slide  
XYH-L2-S9

STUDENT ACTIVITY

89

# EDUCATION

EDUCATION	NAME OF SCHOOL ATTENDED	NO. OF YEARS ATTENDED	GRADUATED YES OR NO	YEAR	DEGREE AND MAJOR
GRADE SCHOOL					X X X X X
HIGH SCHOOL					X X X X X
COLLEGE					
OTHER					

# U. S. MILITARY SERVICE RECORD

BRANCH OF SERVICE	ACTIVE DUTY DATES	TYPE OF DISCHARGE
MILITARY JOB ASSIGNMENT	HIGHEST RANK ATTAINED	RESERVE CATEGORY

# NAMES OF RELATIVES AND FRIENDS NOW WORKING FOR THE COMPANY

NAME	WHERE EMPLOYED
NAME	WHERE EMPLOYED

# GIVE THREE PERSONAL CHARACTER REFERENCES OTHER THAN RELATIVES OR PREVIOUS EMPLOYERS

NAME	ADDRESS	OCCUPATION

HAVE YOU EVER BEEN CONVICTED OF A FELONY?  
IF YES, EXPLAIN.

☐ YES ☐ NO

# IN CASE OF ACCIDENT NOTIFY

NAME	
ADDRESS	TELEPHONE

COMMENTS OR ADDITIONAL INFORMATION:

As a part of our procedure for processing your employment application an investigative report by a consumer reporting agency may be made whereby information is obtained through personal interviews with third parties, such as family members, business associates, financial sources, friends, neighbors or others with whom you are acquainted. This inquiry includes information as to your character, general reputation, personal characteristics, and mode of living, whichever may be applicable. You have the right to make a written request within a reasonable period of time for a complete and accurate disclosure of additional information concerning the nature and scope of the investigation. If such a report, in whole or in part, results in denial of employment, written notification will be made advising the name and address of the appropriate reporting agency.

I authorize any previous employers, educational institutions, and character references listed above to release background information to SCM Corporation.

I understand my employment with SCM Corporation is conditioned upon the statements in this application being true to the best of my knowledge and upon securing a fidelity bond and passing a medical examination both of which must be satisfactory to the Company. I agree that if I shall fail to satisfy any of these conditions of employment, my employment shall be subject to termination by the Company, and I do hereby waive any rights I may have to compensation from SCM Corporation beyond the date when my services are terminated.

SIGNATURE OF APPLICANT

DATE

OUTLINE OF INSTRUCTION

(1) Platings form physical attachment with base metal, not a metallic alloy.

(2) Soldering to plating metal alone is unsatisfactory - no true intermetallic bond established.

(3) Remove plating from area to be soldered.

(a) Use rubberized abrasive if plating is soft like gold.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

# EMPLOYMENT HISTORY

List employment history. Begin with last or current position and work back to least recent position.

Present or Last Employer		Area Code - Tel. No.		May we contact your present employer at this time? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Address					
Nature of Business				Supervisor	
Starting Date		Ending Date		Starting Salary	
Job Title(s) and Description of Duties					
Reason(s) for Leaving					
Which duties would you have preferred to have done more of?					
Which duties would you have preferred to have done less of?					
Employed By				Area Code Tel. No.	
Address					
Nature of Business				Supervisor	
Starting Date		Ending Date		Starting Salary	
Job Title(s) and Description of Duties					
Reason(s) for Leaving					
Which duties would you have preferred to have done more of?					
Which duties would you have preferred to have done less of?					
Employed By				Area Code Tel. No.	
Address					
Nature of Business				Supervisor	
Starting Date		Ending Date		Starting Salary	
Job Title(s) and Description of Duties					
Reason(s) for Leaving					
Which duties would you have preferred to have done more of?					
Which duties would you have preferred to have done less of?					
Employed By				Area Code Tel. No.	
Address					
Nature of Business				Supervisor	
Starting Date		Ending Date		Starting Salary	
Job Title(s) and Description of Duties					

116

OUTLINE OF INSTRUCTION

(b) May be done by tinning heavily, then remove solder and plating. Heat is prime consideration using this method.

(4) Another method of obtaining intermetallic bond on plated surfaces - apply sufficient heat for solvent action - penetrates through plating and forms an alloy with base metal.

(a) Does not work well with heavy plating metals - slow solvent action

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

16



### ADDITIONAL INFORMATION

Please state any additional information which you feel would be helpful to us in considering your application with Aetna.  
(Do not list any information the nature of which would indicate your race, creed, color, national origin or ancestry.)

I understand that employment by Aetna Life & Casualty is conditional upon satisfactory completion of a pre-employment investigation and medical review as required by the company.

I certify that all the information I have given in this application is accurate and complete.

Signed \_\_\_\_\_

### COMPANY EMPLOYMENT RECORD

For Aetna Use Only

Reg. No.	Starting Date	Department	Salary	Date of First Salary Review	Class	Category	Scheduled Hours	Intv.

11.

OUTLINE OF INSTRUCTION

- (b) May cause solder bond to lose strength or become brittle
- (5) Best solution to plating problems - manufacturers starting to hot dip base metals in solder rather than electroplating them.
- (a) Coating forms actual intermetallic bond with base metal rather than physical coating
- (b) Coating easy to solder too

INSTRUCTOR ACTIVITY

- (5) Only necessary for technicians to be aware of its purpose and effects.

STUDENT ACTIVITY

CHECK THE HIGHEST GRADE COMPLETED	HIGH SCHOOL	COLLEGE				GRADUATE			
	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4						

HIGH SCHOOL	SCHOOL NAME	SCHOOL LOCATION
COURSE TAKEN	COMPLETION DATE	

### UNDERGRADUATE SCHOOL

UNDERGRADUATE SCHOOLS ATTENDED	LOCATION	DATES ATTENDED		MAJOR	MINOR
		FROM	TO		

DEGREES EARNED	CLASS STANDING	GRADE POINT AVERAGE
		MAJOR:                      OVERALL:

### LIST OFFICES, HONORS AND EXTRACURRICULAR ACTIVITIES


GRADUATE WORK	MAJOR	UNIVERSITY
LOCATION		HOURS CREDIT
DATES ATTENDED FROM	TO	DEGREE EARNED

OTHER EDUCATION	LIST SEMINARS, SPECIAL COURSES, ETC.

### LIST THREE PERSONS WHO ARE FAMILIAR WITH YOUR PROFESSIONAL ACTIVITIES

NAME	ADDRESS	OCCUPATION
NAME	ADDRESS	OCCUPATION
NAME	ADDRESS	OCCUPATION

HAVE YOU EVER WORKED FOR SCM CORPORATION BEFORE?	<input type="checkbox"/> YES <input type="checkbox"/> NO	IF YES, SHOW DATES, PLACE AND LAST POSITION

### HOW WERE YOU REFERRED TO SCM CORPORATION?

--

OUTLINE OF INSTRUCTION

(c) Method still only at  
manufacturing level

c. Determining if plating harmful  
or advantageous to connections

(1) Only two platings, other  
than hot-dip solder commonly  
used in areas to be soldered

(a) Gold or silver

(b) Other plating used  
but in rare instances  
or in areas not to  
be soldered

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

93

149

**EMPLOYMENT HISTORY**

POSITION 4 - COMPANY NAME AND ADDRESS

DATES (FROM - TO)

MONTHLY EARNINGS

REASON FOR LEAVING

POSITION 5 - COMPANY NAME AND ADDRESS

DATES (FROM - TO)

MONTHLY EARNINGS

REASON FOR LEAVING

**MEDICAL HISTORY**

HEIGHT

WEIGHT

DATE OF LAST PHYSICAL EXAMINATION

REASON FOR LAST PHYSICAL EXAMINATION

LIST ILLNESSES OR ACCIDENTS YOU HAVE HAD IN THE PAST 5 YEARS

LIST ANY PHYSICAL DEFECTS

HAVE YOU EVER BEEN DENIED LIFE INSURANCE?

☐ YES ☐ NO

IF YES, WHY?

**U.S. ARMED FORCES MILITARY HISTORY**

ACTIVE DUTY DATES

TYPE OF DISCHARGE

BRANCH OF SERVICE

HIGHEST RANK ATTAINED

SELECTIVE SERVICE CLASSIFICATION

RESERVE CATEGORY

WHAT MEMBERSHIPS DO YOU HAVE IN BUSINESS, PROFESSIONAL ORGANIZATIONS OR SOCIETIES?

LIST ANY HOBBIES THAT YOU HAVE

HAVE YOU EVER BEEN CONVICTED OF  
A FELONY?☐ YES ☐ NO

IF YES, EXPLAIN

WHAT ARE YOUR MAJOR QUALIFICATIONS FOR THE POSITION FOR WHICH YOU ARE APPLYING?

SALARY REQUIREMENTS

DATE AVAILABLE

In making this application for employment it is understood that an investigative report by a consumer reporting agency may be made whereby information is obtained through personal interviews with third parties, such as family members, business associates, financial sources, friends, neighbors or others with whom you are acquainted. This inquiry includes information as to your character, general reputation, personal characteristics, and mode of living, whichever may be applicable. You have the right to make a written request within a reasonable period of time for a complete and accurate disclosure of additional information concerning the nature and scope of the investigation. If such a report, in whole or in part, results in denial of employment, written notification will be made advising the name and address of the appropriate reporting agency.

I understand my employment with SCM Corporation is conditioned upon the statements in this application being true to the best of my knowledge, and upon securing a fidelity bond and passing a medical examination, both of which must be satisfactory to the company. I agree that if I shall fail to satisfy any of these conditions of employment, my employment shall be subject to termination by the company and I do hereby waive any right I may have to compensation beyond the date where my services are so terminated.

I also agree that if I am employed by SCM Corporation on a salary basis the employment contract period will be the period for which I am paid but in no event shall be longer than one half month, and that this application shall be a part of my employment contract.

SIGNATURE OF APPLICANT

DATE

OUTLINE OF INSTRUCTION

(2) Silver - primarily on terminals and connector pins

(a) Shape and accessibility make plating removal impractical - soldering done with plating intact

(b) Silver wets and alloys well with solder - does not detract from joint strength

(3) Gold - most common plating used in electronic circuitry

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

### EDUCATION

EDUCATION	NAME OF SCHOOL ATTENDED	NO. OF YEARS ATTENDED	GRADUATED YES OR NO	YEAR	DEGREE AND MAJOR
GRADE SCHOOL					XXXXX
HIGH SCHOOL					XXXXX
COLLEGE					
OTHER					

### U. S. MILITARY SERVICE RECORD

BRANCH OF SERVICE	ACTIVE DUTY DATES	TYPE OF DISCHARGE
MILITARY JOB ASSIGNMENT	HIGHEST RANK ATTAINED	RESERVE CATEGORY

### NAMES OF RELATIVES AND FRIENDS NOW WORKING FOR THE COMPANY

NAME	WHERE EMPLOYED?
NAME	WHERE EMPLOYED?

### GIVE THREE PERSONAL CHARACTER REFERENCES OTHER THAN RELATIVES OR PREVIOUS EMPLOYERS

NAME	ADDRESS	OCCUPATION

HAVE YOU EVER BEEN CONVICTED OF A FELONY?  
 IF YES, EXPLAIN. ☐ YES ☐ NO

### IN CASE OF ACCIDENT NOTIFY

NAME	
ADDRESS	TELEPHONE

COMMENTS OR ADDITIONAL INFORMATION:

As a part of our procedure for processing your employment application an investigative report by a consumer reporting agency may be made whereby information is obtained through personal interviews with third parties, such as family members, business associates, financial sources, friends, neighbors or others with whom you are acquainted. This inquiry includes information as to your character, general reputation, personal characteristics, and mode of living, whichever may be applicable. You have the right to make a written request within a reasonable period of time for a complete and accurate disclosure of additional information concerning the nature and scope of the investigation. If such a report, in whole or in part, results in denial of employment, written notification will be made advising the name and address of the appropriate reporting agency.

I authorize any previous employers, educational institutions, and character references listed above to release background information to SCM Corporation.

I understand my employment with SCM Corporation is conditioned upon the statements in this application being true to the best of my knowledge and upon securing a fidelity bond and passing a medical examination both of which must be satisfactory to the Company. I agree that if I shall fail to satisfy any of these conditions of employment, my employment shall be subject to termination by the Company, and I do hereby waive any rights I may have to compensation from SCM Corporation to the date when my services are terminated.

OUTLINE OF INSTRUCTION

(4) Gold plating may be very harmful or very advantageous

(a) Advantages when used on nonsolderable leads if component lead can not be soldered without solderable gold plating

(b) Normally harmful on printed circuit runs, pads and eyelets - detracts from joint reliability

(5) Several detrimental effects caused by gold present in solder connections in quantities greater than 5% by weight

INSTRUCTOR ACTIVITY

(a) Tell students to make certain care must be kept to keep plating on component leads intact...

STUDENT ACTIVITY

95

153



**Blank 21A— Description of Work** — Be sure to review carefully the qualifications indicated on the job announcement and parallel your experience with the requirements listed.

Volunteer experience can be used; however, make sure the experience gained from the volunteer work is *related* to the position you are seeking. Example: You are applying for a bookkeeper position and you volunteered as the treasurer for the P.T.A. This could be considered related experience.

Description of work for previous professional experience should include phrases similar to "I was responsible for . . ."

Description of work for previous clerical experience should include phrases such as:

- 60 wpm
- received data and established log
- transcribed from dictaphone technical reports
- maintained and revised files
- edited correspondence and reports for spelling and punctuation
- reviewed outgoing correspondence for accuracy
- made travel arrangements and prepared expense voucher
- kept staff time sheet
- received telephone messages and visitors
- worked with team of 50 persons

Important things to remember:

- Make sure items listed are related to position you are seeking.
- Make sure information provided parallels the qualifications requested.

Also, when the job announcement requests education or equivalent combinations — if you don't have the exact combination requested — apply *anyway*. There is flexibility in this area.

**Blank 22 —** *Related* volunteer experience can be used such as president of P.T.A. (Public Speaking).

**Blank 23 — A.** If you are currently enrolled in college or high school, indicate the year you expect to get a degree or diploma.

D. & E. List courses taken in your major field of study.

F. List your goal and what you hope to accomplish.

G. Be sure to list related seminars and correspondence courses.

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

- (a) Reduces solder bond strength
- (b) Pull separation strengths measured between cooper wire soldered to gold plated copper run; copper wire soldered to unplated copper run
- (c) Bond with gold present only little over half strength of bond with no gold
- (d) Loss of strength due to gold alloyed with solder. Solder with gold dispersed through becomes weaker part of bond.

- (a) Display Slide YXH-L2-S10

155

96

1-3-35

**ACTIVITY 4: FEDERAL APPLICATION -- To Be Completed**

OUTLINE OF INSTRUCTION

(6) Making and measuring pull test

(a) Bond with no gold present separates at thinnest point.

(b) Bond containing gold separates at surface of copper run where heaviest concentration of gold is present

(7) Gold is detrimental - causes solder bond to become brittle

156

INSTRUCTOR ACTIVITY

(6) Display slide YXH-L2-S11. Note point solder bond separates in each case

1-3-36

STUDENT ACTIVITY

97

157

## ITEM 21. EXPERIENCE

- Allow sufficient time to fill in these experience blocks carefully and completely. A large part of your qualifications rating depends upon a thorough description of your experience and employment history.
- If you fail to give complete details, you may delay consideration of your Statement. Your description of duties may be verified with former employers.
- If you supervise or have supervised other employees, be sure to indicate the number and kind (and grades, if Federal Government) of employees supervised, and describe your duties as a supervisor under Description of Work.
- Volunteer Experience—You may receive credit for pertinent religious, civic, welfare, service and organizational work performed with or without compensation. Show the actual amount of time spent in such work (for example, average hours per week or month). Complete all the items just as you would for a compensable position.
- Use separate blocks if your duties, responsibilities, or salary have changed materially while working for the same employer. Treat each such change as a separate position.  
NOTE—Experience gained more than 15 years ago may be summarized in one block if it is not pertinent to the type of position you applied for.
- Include your military or merchant marine service in separate blocks in its separate order and describe major duty assignments.
- Indicate in each block of Item 21 the name under which you were employed if it was different from the name in Item 6 of this Statement. Show former name in parentheses after "Description of duties and accomplishments in your work."
- Indicate periods of unemployment exceeding three months and your address at that time on the last line of the preceding experience block.
- Block A—Describe your present position in this block. Indicate if you are now unemployed or if you have never been employed.
- Blocks B and C—Describe in block B the position you held just before your present position and continue to work backwards using block C.
- Enter the average number of hours per week you work. If you work part time, indicate the average number of hours per week you work.
- Description of work—Describe each job briefly, including required skills and abilities. Describe any specialties and special assignments, your authority and responsibility, your relationships to others, your accomplishments, and any other factors which help to describe the job.
- If your job contains experience in more than one type of work (for example, carpentry and painting, or personnel and budget) estimate and indicate the approximate percentage of time spent in each type of work. Place the percentages in parentheses at the end of the description of work.
- If you need additional experience blocks:
  - Use Standard Form 171-A, Continuation Sheet, or
  - A plain sheet of paper approximately 8 by 10½ inches in size. Be sure to include all of the information requested in Item 21.
- If you need additional space to describe a position held:
  - Continue in Item 35, Space for detailed answers, or
  - Continue on a plain sheet of paper

## ITEM 21. EXPERIENCE—(Continued)

- Identify each plain sheet of paper used by showing your name, birth date, examination or position title, and the block under Item 21 from which the description is continued.
- Attach all supplemental sheets to the top of page 3.

## ITEMS 32 and 33. RELATIVES EMPLOYED BY THE UNITED STATES GOVERNMENT

- A Federal official (civilian or military) may not appoint any of his or her relatives or recommend them for employment in his or her agency, and a relative who is appointed in violation of this restriction cannot be paid. Thus it is necessary to have information about your relatives who are working for the Government. In listing relative(s) in answer to question 32 include: father; mother; son; daughter; brother; sister; uncle; aunt; first cousin; nephew; niece; husband; wife; father-in-law; mother-in-law; son-in-law; daughter-in-law; brother-in-law; sister-in-law; stepfather; stepmother; stepson; stepdaughter; stepbrother; stepsister; half brother; and half sister.
- Question 33 is needed because of restrictions in making a career or career-conditional appointment in the competitive service when a person is not entitled to veteran preference and two or more members of his or her family are already serving in the competitive service under a career or career-conditional appointment.

## CERTIFICATION

- Be careful that you have answered all questions on your Statement correctly and considered all statements fully so that your eligibility can be decided on all the facts. Read the certification carefully before you sign and date your Statement.
- Sign your name in ink.
- Use one given name, initial or initials, and last name.

## PRIVACY ACT INFORMATION

The U.S. Civil Service Commission is authorized to rate applicants for Federal jobs under sections 1302, 3301, and 3304 of Title 5 of the U.S. Code. We need the information you put on this form to see how well your education and work skills fit you for a Federal job. We also need information on matters such as citizenship and military service to see whether you are affected by laws we must follow in deciding who may be employed by the Federal Government. We cannot give you a rating, which is the first step toward getting a job, if you do not answer these questions.

We must have your Social Security Number (SSN) to keep your records straight because other people may have the same name and birthdate. The SSN has been used to keep records since 1943, when Executive Order 9397 asked agencies to do so. The Civil Service Commission may also use your SSN to make requests for information about you from employers, schools, banks, and others who know you, but only where that is allowed by law. The information we collect by using your SSN will be used for employment purposes and also for studies and statistics that will not identify you.

Information we have about you may also be given to Federal, State, and local agencies for checking on law violations or other lawful purposes. We may also notify your school placement office if you are selected for a Federal job.

PLEASE DETACH THIS INSTRUCTION SHEET BEFORE SUBMITTING YOUR STATEMENT

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>(a) Brittle bond highly undesirable. Subject to cracking under stress due to thermal expansion and contraction</p> <p>(b) Brittleness caused by porous nature of gold</p> <p>(c) Visual indication - rough "frosty" solder connection</p> <p>(8) Gold on solder bond decreases wetting action</p>		

# Personal Qualifications Statement

Read instructions before completing form

Form Approved:  
O.M.B. No. 50-R0387

1 Kind of position (job) you are filing for (or title and number of announcement)					
2 Options for which you wish to be considered (if listed in the announcement)					
3 Home phone Area Code      Number	4 Work phone Area Code      Number      Extension				
5 Preferred title (mark one) <input type="checkbox"/> Mr <input type="checkbox"/> Mrs. <input type="checkbox"/> Miss <input type="checkbox"/> Ms.					
6 Other last names ever used (e.g., Maiden)					
7 Name (Last, First, Middle)  Street address or PFD no. (include apartment no., if any)  City      State      ZIP Code					
8 Birthplace (City & State, or foreign country)					
9 Birth date (Month, day, year)	10 Social Security Number				
11. If you have ever been employed by the Federal Government as a civilian, give your highest grade, classification series, and job title.  Dates of service in that grade (Month, day, and year) From      To					
12. If you currently have an application on file with the Civil Service Commission for appointment to a Federal position, (a) list the name of the area office maintaining your application, (b) the position for which you filed, and (if appropriate) (c) the date of your notice of rating, (d) your identification number, and (e) your rating.					
13. Lowest pay or grade you will accept <table border="1" style="width: 100%;"><tr><td>PAY</td><td>GRADE</td></tr><tr><td>\$      per</td><td>OR      </td></tr></table>	PAY	GRADE	\$      per	OR	14. When will you be available for work? (Month and year)
PAY	GRADE				
\$      per	OR				
15 Are you available for temporary employment lasting: (Acceptance or refusal of temporary employment will not affect your consideration for other appointments) A. Less than 1 month?      YES NO B. 1 to 4 months?      YES NO C. 5 to 12 months?      YES NO					
17 Where will you accept a job A. In the Washington, D.C. Metropolitan area?      YES NO B. Outside the 50 United States?      YES NO C. Anyplace in the United States?      YES NO D. Only in (specify locality):      YES NO	18 Indicate your availability for overnight travel. A. Not available for overnight travel      YES NO B. 1 to 5 nights per month      YES NO C. 6 to 10 nights per month      YES NO D. 11 or more nights per month      YES NO				
19. Are you available for part-time positions (fewer than 40 hours per week) offering: A. 20 or fewer hours per week?      YES NO B. 21 to 31 hours per week?      YES NO C. 32 to 39 hours per week?      YES NO					
20 Veteran Preference. Answer all parts. If a part does not apply to you, answer "NO". A Have you ever served on active duty in the United States military service? (Exclude tours of active duty for training in Reserves or National Guard) ..... YES NO B Have you ever been discharged from the armed services under other than honorable conditions? (You may omit any such discharge changed to honorable or general by a Discharge Review Board or similar authority.) ..... YES NO If "YES", give details in item 35. C Do you claim 5 point preference based on active duty in the armed forces? ..... YES NO If "YES" you will be required to furnish records to support your claim at the time you are appointed. D Do you claim 10 point preference? ..... YES NO If "YES", check the type of preference claimed and complete and attach Standard Form 15, "Claim for 10 Point Veteran Preference", together with the proof requested in that form Type of Preference <input type="checkbox"/> Compensable Disability <input type="checkbox"/> Non-compensable Disability <input type="checkbox"/> Purple Heart Recipient <input type="checkbox"/> Spouse <input type="checkbox"/> Widow(er) <input type="checkbox"/> Mother					
E List dates, branch, and serial number of all active service (enter "N/A" if not applicable). From      To      Branch of Service      Serial or Service Number					

## DO NOT WRITE IN THIS BLOCK FOR USE OF EXAMINING OFFICE ONLY

Material		Entered register	
<input type="checkbox"/> Submitted			
<input type="checkbox"/> Returned			
Notations:			
Form reviewed.			
Form approved:			
Option	Grade	Earned Rating	Preference
			<input type="checkbox"/> 5 Points (Tent.)
			<input type="checkbox"/> 10 Points Comp. Dis.
			<input type="checkbox"/> Other 10 Points
			<input type="checkbox"/> Disal.
			<input type="checkbox"/> Being Investigated
Initials and date			

ANNOUNCEMENT NO.      STATEMENT NO.

THIS SPACE FOR USE OF APPOINTING OFFICER ONLY  
Preference has been verified through proof that the separation was under honorable conditions, and other proof as required.

☐ 5-Point    ☐ 10-Point Compensable Disab.    ☐ 10-Point Other

Signature and title

Agency      Date

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(a) Very high dihedral  
angle of wetting

(b) Reduces spread area  
of applied solder

(9) Due to detrimental effects  
of gold on solder connec-  
tions - necessary to remove  
gold plating from connection  
areas whenever possible,  
before soldering

6. Characteristics and fabrication -  
quality solder joint

a. Physical appearance

66

161





OUTLINE OF INSTRUCTION

- (1) Smooth shiny mirror like surface
- (2) Surface totally free of any pits, protrusions or other blemishes
- (3) No copper showing through soldered area
- (4) Smooth convex fillets between component lead and surface to be soldered
- (5) Most critical indication of quality and reliability of connection - wetting action

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

9181-82P1

1-3-39

100

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(a) No inlets - edge of soldered area

(b) Solder must wet and blend smoothly into soldered surface - leaving no sharp edges or ridge at any point

b. Allowable solder quantity

(1) Preferred quantity

(a) Smooth concave fillet from point one half way up side of lead

b. Display Slide YXH-L2-S12

101

165

OUTLINE OF INSTRUCTION

(b) Contour of wire or lead  
clearly visible through  
solder

(2) Acceptable quantity

(a) Fillet only slightly  
concave

(b) Fillet starts 3/4 up  
side of lead

(3) Excessive solder REJECT

INSTRUCTOR ACTIVITY

(2) Display Slide  
YXH-L2-S13

(3) Display Slide  
YXH-L2-S14

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

103

(a) Fillet convex

(b) Not possible to tell  
if lead is even in  
solder joint

(c) Air pockets possible  
to exist within joint  
and not show through  
to solder surface

(4) Insufficient solder REJECT

(4) Display Slide  
YXH-L2-S15

169

168

OUTLINE OF INSTRUCTION

(a) Fillet, although concave, starts well below halfway point of lead

(b) Intermetallic bond good but not enough to withstand vibration and expansion stresses

c. Internal structure

(1) Internal metallic structure consists of several different alloys

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

(2) Alloys that make up solder connection between tinned copper lead and copper printed circuit pad

(a) Solid copper foaming pad

(b) Copper, tin and lead alloy - surface of pad

(c) Tin/lead alloy - center of joint

(d) Copper, tin and lead alloy - surface of component lead

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

105.

173.

## ACTIVITY 2: JOB-SEARCH RESOURCES -- PROBLEM-SOLVING

Name \_\_\_\_\_

Date \_\_\_\_\_

Please provide solutions for the following situations.

I

Mr. Peters was Rachel's advisor in her senior year in high school. She has been out of school for three years now and used Mr. Peters as a reference on her resume for a bank clerk job. Mr. Peters receives a call from the National Bank asking about Rachel's grades, personality, and other important information. Mr. Peters is uncertain as to who Rachel is and angry that she used his name without his knowing. What should Rachel have done prior to using Mr. Peters' name?

---

---

---

II

Jane Doe had an interview with NIC Insurance. She was well groomed and confident about the clerical position she sought. After the greetings, the interviewer asked Jane, "What do you know about our company?" Jane sat puzzled, with no answer. How did this reflect on Jane and her job pursuit? How could she have avoided this sticky situation?

---

---

---



OUTLINE OF INSTRUCTION

(e) Copper forming lead

(f) Alloys must be complete -  
no air pockets foreign  
substance or solder  
defects in, joint to  
obtain reliable internal  
structure

(3) Only positive text - Xray-  
ing or destructive examina-  
tion, neither practical  
for technicians

(4) Must judge internal quality  
by learning external  
appearance of defects and  
causes.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

V

Pat just completed her Data Entry course at RACC. Although she's been looking at newspaper ads and other employment sources, she is very interested in working for the government. Where can she get more information on Civil Service employment (federal or state) and how can she apply?

---

---

---

VI

Often the many people you know and are daily involved with have information that can prove helpful in the job search. If they don't know of an actual job opening, often they can refer you to someone else who may have a connection. Of the following list of contacts you may have, select six (6) that you think would be the most helpful and informative and why?

Personal Contact List:

Former employers, close friends, doctor/dentist, lawyer, banker, minister, club members, neighbors, caseworkers, neighborhood store owners, barber/beautician, people in armed services, teachers/school friends, civic/community leaders, relatives, local legislators, real estate agents.

---

---

---

OUTLINE OF INSTRUCTION

7. Solder joint defects

a. Description common defects

(1) NASA lists 40 different  
joint defects

(2) Defects fall under five  
major categories

(a) Dirty solder joint

176

9183-84P1

INSTRUCTOR ACTIVITY

7. Display Slide  
YXH-12-S15A

1-3-46

STUDENT ACTIVITY

107

177

## ACTIVITY 1: INTERVIEW CHECKLIST

- \_\_\_\_\_ 1. Arrived for the interview on time - even a few minutes early
- \_\_\_\_\_ 2. Came into the interview alone
- \_\_\_\_\_ 3. Greeted receptionist
- \_\_\_\_\_ 4. Stated his or her name
- \_\_\_\_\_ 5. Identified his or her purpose in being there
- \_\_\_\_\_ 6. Stood, shook hands when introduced
- \_\_\_\_\_ 7. Had a firm handshake
- \_\_\_\_\_ 8. Well groomed
- \_\_\_\_\_ 9. Good posture
- \_\_\_\_\_ 10. Good eye contact
- \_\_\_\_\_ 11. Smoked only when appropriate
- \_\_\_\_\_ 12. Had a copy of resume
- \_\_\_\_\_ 13. Did not chew gum
- \_\_\_\_\_ 14. Did not place hands, elbows or paper on interviewer's desk
- \_\_\_\_\_ 15. Absence of nervous habits or mannerisms
- \_\_\_\_\_ 16. Was well prepared
- \_\_\_\_\_ 17. Indicated interest in company and job
- \_\_\_\_\_ 18. Let the interviewer take the lead
- \_\_\_\_\_ 19. Gave clear and concise answers to questions
- \_\_\_\_\_ 20. Understood how and when to follow-up the interview
- \_\_\_\_\_ 21. Expressed self confidence in speech
- \_\_\_\_\_ 22. Avoided criticism of others
- \_\_\_\_\_ 23. Was a good listener
- \_\_\_\_\_ 24. Secured information as to when final decision would be made
- \_\_\_\_\_ 25. Thanked the interviewer for his time and consideration
- \_\_\_\_\_ 26. Asked pertinent questions concerning the job

OUTLINE OF INSTRUCTION

1. Edge of solder shows lack of good wetting/dewetting action.
  2. Only one portion shows dewetting
  3. Dewetted area has small inlets where solder didn't flow
- (b) Cold solder joint - good outward appearance except for wetting action.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

## ACTIVITY 1: INTERVIEW CRITIQUE

Student's Name \_\_\_\_\_

Date \_\_\_\_\_

Check One:

Interview Critique-This critique of the participant's performance at the mock interview serves as a tool to promote improvement and to provide self-evaluation:

## 1. Appearance

\_\_\_\_ Excellent

\_\_\_\_ Above Average

\_\_\_\_ Average

\_\_\_\_ Below Average

## 2. Maturity

\_\_\_\_ Excellent

\_\_\_\_ Above Average

\_\_\_\_ Average

\_\_\_\_ Below Average

## 3. Anticipated Competence

\_\_\_\_ Excellent

\_\_\_\_ Above Average

\_\_\_\_ Average

\_\_\_\_ Below Average

## 4. Interest

\_\_\_\_ Excellent

\_\_\_\_ Above Average

\_\_\_\_ Average

\_\_\_\_ Below Average

## 5. Attitude

\_\_\_\_ Excellent

\_\_\_\_ Above Average

\_\_\_\_ Average

\_\_\_\_ Below Average

## 6. Interview Preparation

\_\_\_\_ Excellent

\_\_\_\_ Above Average

\_\_\_\_ Average

\_\_\_\_ Below Average

OUTLINE OF INSTRUCTION

1. Dewetting seen  
around most  
soldered surface

2. Small protrusion  
of solder on  
surface where  
soldering iron  
tip was removed.

(c) Fractured or dis-  
turbed solder joint

1. Surface usually  
semi-shiny -  
good wetting

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

101

181

180

9183-84P1

1-3-48

## VII. LEARNING ACTIVITIES: JOB SURVIVAL UNITS

### A. LESSON PLAN: ATTITUDES

**Unit Objective:** To explore the significance of a positive personal attitude as a factor in job survival.

**Performance Objective:** At the completion of this unit the student will be able to:

- Identify from a list of terminology, terms which apply to developing a positive job survival attitude.
- Identify from a given list of positive and negative attitude statements, the positive job survival attitude statements.
- List at least three advantages of displaying a positive job survival attitude.
- Write a factual example of a person displaying a positive job survival attitude.

**Skills Emphasized:**

- Understanding the significance of a positive personal attitude.
- Distinguishing between negative and positive job survival attitudes.

**Materials and Equipment:**

- Job survival attitude quizzes.

**Activities:**

1. Each student will complete two short quizzes to evaluate his/her understanding of personal job survival attitudes.
2. Each student will write an example of a person displaying the desired positive job survival attitude.



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

2. Spider web cracked appearance on surface of solder
3. Large cracks around component leads
- (d) Overheated solder joint - mistakenly called cold solder joint but appearance is quite different
1. Surface generally quite dull

## ACTIVITY 2: JOB SURVIVAL ATTITUDES QUIZ

Student's Name \_\_\_\_\_

Date \_\_\_\_\_

1. Indicate P (Positive Attitude) in the space next to the word or phrases that reflect a positive job survival attitude.

- \_\_\_\_\_ Dependable
- \_\_\_\_\_ Takes inefficient short cuts
- \_\_\_\_\_ Makes suggestions for improvement
- \_\_\_\_\_ Makes excuses for incomplete work
- \_\_\_\_\_ Volunteers to work overtime during heavy periods
- \_\_\_\_\_ Constantly talking to co-workers
- \_\_\_\_\_ Asks supervisor or trainer for instructions

2. List at least three advantages of displaying a positive job survival attitude.

---



---



---

3. Write a factual example of a person displaying a positive job survival attitude.

---



---



---

4. Revise one of the following negative job survival statements to a positive job survival attitude statement.

- Why don't they make up their minds, they give me all this work and I don't know what to do first.
- I am so tired of listening to Joan talk about her husband, I can't concentrate.

---



---

OUTLINE OF INSTRUCTION

2. Rough, grainy or  
sandy appearance

3. Appearance lumpy  
rather than sandy  
if overheat just  
beginning

(e) Dead solder

1. Crusty wrinkled  
appearance - film  
over solder surface

2. Very dark dull  
color - may have  
faint light and  
dark streaks

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

///

185

9183-84PT

184

1-3-50

## ACTIVITY 1: JOB SURVIVAL PERSONAL GOALS QUIZ

Student's Name \_\_\_\_\_

Date \_\_\_\_\_

1. Define a personal relation goal and contrast the personal relation goal with other kinds of goals.

a. \_\_\_\_\_

b. \_\_\_\_\_

2. List two (2) short range personal relation goals.

a. \_\_\_\_\_

b. \_\_\_\_\_

3. List one long range work goal.

\_\_\_\_\_

4. Select one of the short range personal relation goals from number 2 and complete the following format:

a. Short range goal: \_\_\_\_\_

b. Steps to accomplish goal

Completion Date

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

6. \_\_\_\_\_

7. \_\_\_\_\_

5. Use the long range personal relation goal listed in Number 3 and complete the following format:

a. Long range goal: \_\_\_\_\_

b. Steps to accomplish goal

Completion Date

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

OUTLINE OF INSTRUCTION

b. Causes of common defects

- (1) Dirty solder joint -  
oxidation or other foreign  
matter interfering with  
wetting action
- (2) Cold solder joint -  
insufficient heat applied -  
poor heat transfer from  
iron tip
- (3) Fractured solder joint -  
physical movement of  
solder while changing from  
liquid to solid
- (4) Overheated solder joint -  
too much heat - too long

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

9185-86P1

1-3-51

187

2112

146

## ACTIVITY 1: COMMUNICATION QUIZ

Student's Name \_\_\_\_\_

Date \_\_\_\_\_

1. Define effective communication. \_\_\_\_\_  
\_\_\_\_\_
2. List two factors that impede effective communication. \_\_\_\_\_  
\_\_\_\_\_
3. List five factors that aid effective communication. \_\_\_\_\_  
\_\_\_\_\_
4. State two reasons why effective communication is important on the job.  
\_\_\_\_\_  
\_\_\_\_\_
5. Write a definition of non-verbal behavior and provide an example in which non-verbal communication adversely affects communication. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

OUTLINE OF INSTRUCTION

- (5) Dead solder - very extreme  
overheat - solder may  
actually begin to separate  
generally seen in solder  
left on tip of iron when  
not in use...

8. Safety precautions

a. Personnel

b. Tool safety

INSTRUCTOR ACTIVITY

8. Safety precautions  
are the same as  
presented in Lesson  
1.2. Reinforce  
students on the  
importance of observ-  
ing all of them at  
all times...

STUDENT ACTIVITY

113

189

#### D. LESSON PLAN: GENERAL SKILLS

Unit Objective: To reinforce the identification of skills employers seek.

Performance Objective: At the completion of this unit the student will be able to:

- List the five most important skills employers seek in an employee.
- List the seventeen skills discussed in class that employers seek in an employee.
- Select ten of the above skills and give an example of these skills in use.
- List five reasons employees are terminated. (Items must be taken from classroom guidelines.)
- List five tips for keeping a job. (Taken from classroom guidelines.)
- Identify ten tasks that a new employee should accomplish during the first week on a new job.
- State a procedure for learning a job. (Using classroom guidelines.)
- Write a definition of an interpersonal problem.
- List two potential interpersonal problems people may have.
- Identify appropriate means from a given list of means that includes both appropriate and inappropriate means for a given situation.
- Generate a minimum of five distinct means for a given situation.
- Prioritize by appropriateness the means generated in the prior competency.
- State two reasons time management is important on the job. (Using classroom guidelines.)
- Complete and review a time log for one day and complete a personal twenty-four hour time schedule.

#### Skills Emphasized:

- Understanding the important skills employers seek.
- Understanding interpersonal problems.
- Understanding the importance of time management.

#### Materials and Equipment:

- List of skills
- Job-keeping tips handouts
- Organizational chart
- Interpersonal problems quiz
- Time log
- Skills quiz

#### Activities:

1. Quiz — Each student will complete a quiz on the important skills employers seek.
2. Each student will fill out a time log sheet to practice time management.
3. Each student will complete a quiz on interpersonal problems and solutions.



OUTLINE OF INSTRUCTION

c. Electrical

III. APPLICATION - NONE

IV. SUMMARY

A. Introduction

1. Nature of summary.

2. Purpose of summary.

INSTRUCTOR ACTIVITY

A. Emphasize importance of the summary for the student.

STUDENT ACTIVITY

**ACTIVITY 2: TIPS ON KEEPING A JOB**

1. Once hired learn all you can about the job.
2. Be on time.
3. Get along with fellow workers.
4. Don't be a clock watcher.
5. Be reliable and dependable.
6. Be an honest and trustworthy person.
7. Be a worker, not an idler.
8. Have a sense of humor — don't be gloomy.
9. Be alert — don't go to work under the influence of drugs or alcohol.
10. Follow orders and get your job done.
11. Take only allowed breaks.
12. Call in when sick or when you are going to be late.
13. Don't miss too many days.
14. Be where you're supposed to be, doing what you're supposed to be doing, when you are supposed to be doing *IT*.

OUTLINE OF INSTRUCTION

- (5) Dead solder - very extreme  
overheat - solder may  
actually begin to separate  
generally seen in solder  
left on tip of iron when  
not in use...

8. Safety precautions

a. Personnel

b. Tool safety

INSTRUCTOR ACTIVITY

8. Safety precautions  
are the same as  
presented in Lesson  
1.2. Reinforce  
students on the  
importance of observ-  
ing all of them at  
all times...

STUDENT ACTIVITY

M3

189

## ACTIVITY 4: INTERPERSONAL PROBLEM-SOLVING

Student's Name \_\_\_\_\_ Date \_\_\_\_\_

1. Define an interpersonal problem. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_2. List two potential interpersonal problems people may have. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_3. Identify appropriate means from the list on the board. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_4. Generate eight means from a situation given in class. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_5. Prioritize by appropriateness the means generated in number 4. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

OUTLINE OF INSTRUCTION

c. Electrical

III. APPLICATION - NONE

IV. SUMMARY

A. Introduction

1. Nature of summary.

2. Purpose of summary.

INSTRUCTOR ACTIVITY

A. Emphasize importance of the summary for the student.

STUDENT ACTIVITY

## TIME MANAGEMENT

### Daily Time Schedule

**Student's Name** \_\_\_\_\_

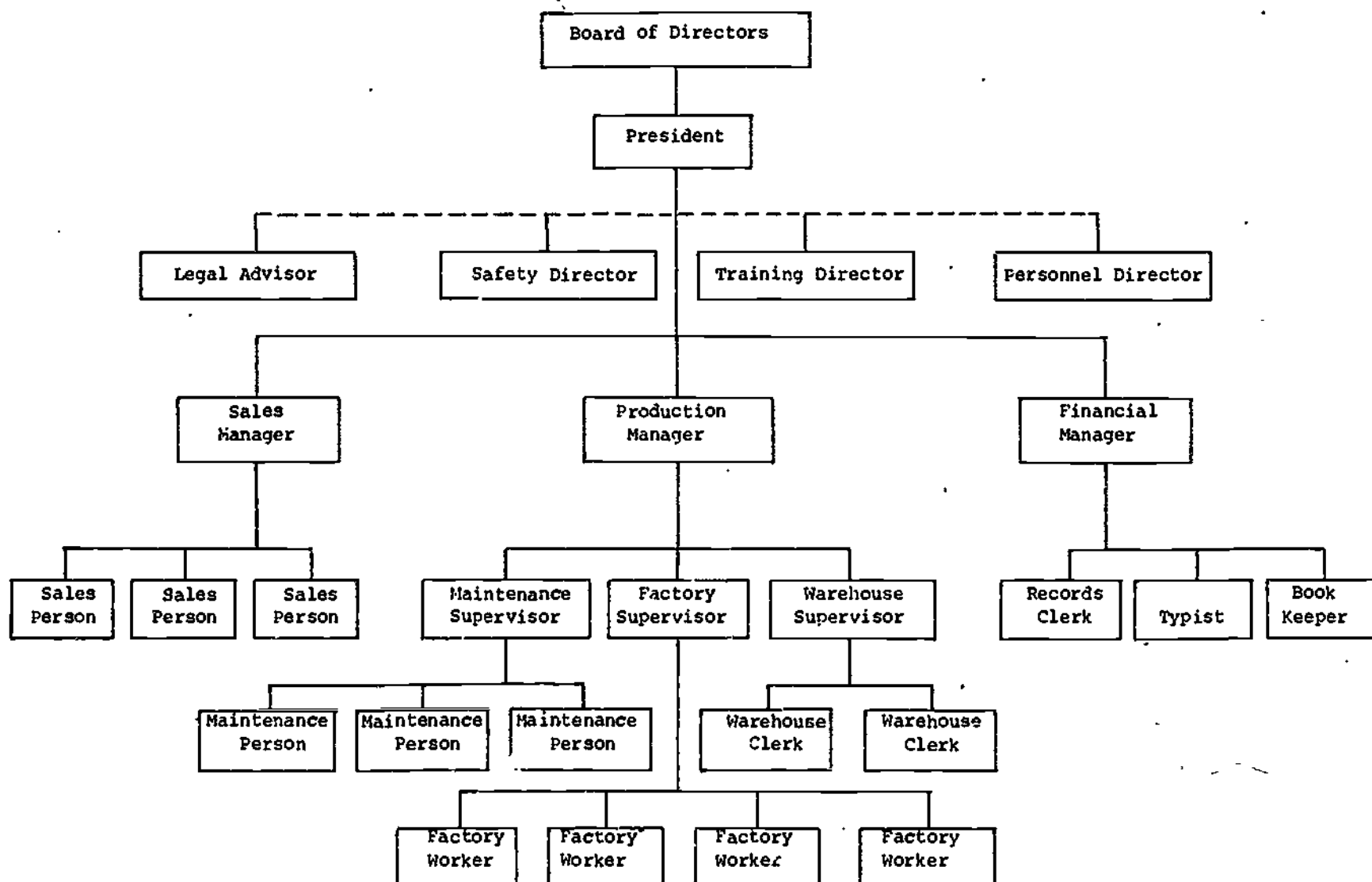
Date \_\_\_\_\_

[illegible]

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
B. Directions to students.		
1. Questions		
2. Notes		
C. Recap of lesson	C. Emphasize safety. Summarize main points of lesson,	C. Ask questions if material not clear, check notes to insure accuracy and completeness.

115

19





<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>V. <u>INFORMAL TEST</u></p> <p>There is no informal test for this lesson topic.</p>		
<p>VI. <u>ASSIGNMENT</u></p> <p>Assignment Sheet 1-3-1A</p>	<p>Provide students with the homework assignment.</p>	<p>Ask questions if the assignment is unclear. Complete assignment.</p>

## ACTIVITY 2: JOB DESCRIPTION

JOB TITLE: General Clerk

JOB CODE: 004

FLSA: 00

## BASIC FUNCTION:

Performs a wide variety of non-technical office work requiring the exercise of limited judgment and responsibility within prescribed procedures.

## TYPICAL DUTIES:

1. Maintains records of individual or departmental activities and prepares miscellaneous reports as required.
2. Selects and completes form letters or printed forms needed in routine work of the department.
3. Reviews papers in order to sort and forward within department or to other departments.
4. Calculates amounts using figures taken from tables, manuals or other specified sources.
5. Compiles lists of numerical and/or verbal data from information at hand.
6. Posts to and maintains card files, reports and other office records.

## NOTE:

Duties to be performed by various levels will be recorded under levels of proficiency.

## LEVELS OF PROFICIENCY:

04004 General Clerk A

High school background, preferred; previous experience as a grade 03 General Clerk; learning time six months.

## Comments:

Involves typical duties 1 thru 6 with indepth knowledge of methods and procedures, composes and/or dictates correspondence and checks work performed by grade 03 General Clerks for accuracy and conformance to procedure.

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair  
(2M). Program A-100-0034

Lesson Topic 1.4:  
Preventive Maintenance of the 2M Repair Station

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 1.0 Hours  
Laboratory - 1.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment
  - a. MERP/2M Kit
2. Training Aids
  - a. Slides
3. Training Aids Equipment
  - a. Slide projector
  - b. Screen, projection, standard
4. Text
  - a. Student's Guide
5. Reference
  - a. Technical Manuals for SX-200 and SX-300

TERMINAL OBJECTIVE

Supported entirely by this lesson topic:

- 9.0 PERFORM preventive maintenance on the 2M Repair Station following the procedures and to the standards outlined in the applicable technical manuals.

ENABLING OBJECTIVES

When you complete this lesson topic, you will be able to:

- 1.4.1 PERFORM daily preventive maintenance actions on the SX-200 Solder Extractor following the procedures outlined in the technical manual.
- 1.4.2 SERVICE hot cubby unit daily as outlined in the PACE Maintenance Manual for the SX-300 System.
- 1.4.3 INSPECT and CLEAN the Moto tool as required to remove all foreign matter.

CRITERION TEST

The student will perform the preventive maintenance actions on the SC-200 Extractor and hot cubby unit of the SX-300 System daily, as prescribed in the appropriate manual.

The student will keep the Moto tool clean of all foreign matter by inspection and cleaning as required while using it.

## ACTIVITY 3: PERFORMANCE APPRAISAL

OUTLINE OF INSTRUCTION

I. INTRODUCTION

A. Contact

B. Readiness

INSTRUCTOR ACTIVITY

A. Introduce self and topic.  
Provide for students needs:

1. Muster

2. Comfort

3. Visibility and seating

B. Explain value of subject  
matter, pointing out where  
appropriate, its relationship  
to the following:

STUDENT ACTIVITY

118

199

Analysis of Job Performance. List all the significant aspects or activities of the position (refer to job description) referencing standards of performance and specific results and accomplishments with respect to those standards. Each item should be assigned a percentage to indicate its relative priority; the sum total of these percentages must equal 100%. Each activity should then be rated on the following scale:

1. Job performance is unacceptable
2. Meets some standards
3. Meets all standards of the position as outlined
4. Exceeds all standards for this position
5. Outstanding performance

The percentage for each item should be multiplied times its rating.

The resultant evaluation for all items should be added together.

(Use additional page if necessary to complete this section.)

	Percentage x Rating = Evaluation		
ITEM 1	_____	_____	_____
ITEM 2	_____	_____	_____
ITEM 3	_____	_____	_____
ITEM 4	_____	_____	_____
ITEM 5	_____	_____	_____
Sum of Evaluations	100%	_____	_____

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Accomplishment of daily tasks aboard ship.
2. The necessity of the skills and techniques in repair of printed circuit boards.
3. Personal applications of the knowledge and skills.
4. Seek to motivate. Tell a good tie-in story if possible.

Comment on what you consider to be the employee's weakest points. What can the employee do to improve in this area as it relates to more effective job performance.

Additional Comments:

Evaluation from Analysis of Job Performance \_\_\_\_\_

Evaluation from Accomplishments \_\_\_\_\_

Overall Evaluation (average of the above two) \_\_\_\_\_



<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
C. Effect	C. When following a subject matter lesson topic, do the following: <ol style="list-style-type: none"> <li>1. Explain relationship of this lesson to previous lesson(s)</li> <li>2. Commend students for mastery of skills in previous lesson(s)</li> </ol>	120
D. Overview	D. Overview lesson by:	203

**OCCURRENCE.** Either a single day of absence or multiple consecutive days of absence due to a single cause. For example, an employee who is absent on a consecutive Tuesday, Wednesday, and Thursday due to the same cause will have three absences but only one occurrence of absence.

Multiple days of absence which are not consecutive, but are a result of a single cause, may be judged as a single occurrence. A management decision, after a review of the circumstances, must be made by the area/section manager in these cases.

## **POLICY**

### **Attendance**

Employees must maintain a reasonable record of acceptable attendance. Attendance standards are explained below.

Employees must notify their immediate supervisor/manager within one hour of their normal starting time if they are sick or will be unexpectedly absent.

New employees are subject to termination within the first ninety days of employment if their absence exceeds more than two occurrences without good cause.

Employees who do not meet minimum levels of attendance may be subject to disciplinary action, including termination.

The employee's attendance record, because of its importance to the company, will be considered in all performance reviews, and may have a positive or negative impact on the overall rating of the employee's performance. For this reason, it is imperative that accurate records be kept on a daily basis on the Attendance and Tardy records maintained in the area.

### **ATTENDANCE STANDARDS**

Attendance standards are stated in terms of occurrences, not days, as listed below:

<u>Occurrences In A 365 Day Period</u>	<u>Performance Rating (Dependability)</u>
0-1	Outstanding
2-3	Superior
4-5	Competent
6	Needs Improvement
7	Unsatisfactory

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Stating learning objectives as contained on cover pages to this topic.

2. Stating procedures to be followed by the lesson.

a. Taking notes

b. Asking questions

c. Use of criterion test.

1-4-5

121

exceeds more than two occurrences without good cause. After the first occurrence of absence within the first ninety days, the employee should be counseled and reminded of the attendance policy. Following the second occurrence of absence within the first ninety days, a recommendation for termination may be made.

## INSTRUCTIONS

### Record Keeping

Absences must be recorded on the Attendance and Tardy card on a daily basis.

**OCCURRENCES** of absence must be recorded as a "rolling number" reflecting the number of occurrences in any 365-day period. This refers to the actual last 365 days, not a calendar or anniversary year.

Each time an employee is absent, the number of occurrences of absence within the last 365 days must be recomputed. Each time an occurrence of absence is recorded, count the total number of occurrences for the past 365 days and record that number. For example, if an employee's attendance record is as follows:

Absence	Days Absence	Total Number of Occurrences
10/17/78-10/19/78	3	1
11/2/78	1	2
12/10/78	1	3
5/1/79-5/3/79	3	4
9/6/79	1	5
11/3/79	1	4

Note that the occurrences of absence recorded following 11/3/79 absence is 4. This results from counting back the number of occurrences within the *past 365 days*. In the example, there have been 4 occurrences of absence from 11/3/78 to 11/3/79. Any occurrences of absence from a period of more than 365 days back should be deducted from the cumulative total.

### Verbal Warning

Managers and supervisors must assure that employees understand the necessity for good attendance. As adverse trends of absenteeism occur, managers and supervisors must counsel the employee to determine the reasons for the absences in an effort to aid the employee in preventing recurrences and stress the importance of good attendance to the company.



Standards for tardiness must be established within each division or, if appropriate, at the area level. In the home office these standards are set by the division heads. In field locations, a standard should be developed for each office. The standards are set by the branch manager, subject to review by the regional personnel manager.

Tardiness standards must be reasonable and not more restrictive than attendance standards. These standards must be communicated to all employees affected by them.

Accurate records concerning the incidents of tardiness must be maintained by the manager/supervisor. When tardiness exceeds the standards set within the division/area, corrective action may be taken. Corrective action for tardiness will follow the same basic procedures outlined above for absenteeism.

#### MANUAL UPDATE

This material will be placed in the Personnel Manual.

#### QUESTIONS

If you have any questions, please refer them to Employee Relations.

OUTLINE OF INSTRUCTION

(1) Check pump filters

(a) Clean every 20 operating hours or if vacuum drops below 15 inches.

(b) The pump filters must be cleaned at regular intervals varying with the extent of coating volatiles removed by extraction and usage.

1 Unplug unit

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

208

209

123

Note: One day vacations and extensions of funeral leave require prior approval during the employee's regularly scheduled shift prior to the day in question.

6. *Long Absence* — Any contiguous chargeable absence of three or more days.
7. *Lateness* — any absence beyond the first 15 minutes of a shift. Excludable absence cases apply as appropriate.
8. *Leaving Early* — any absence at the end of a shift of up to eight (8) hours. Excludable absence cases apply as appropriate.

Note: An absence occurs when a left-early is in excess of eight (8) hours.

9. Progressive discipline for this policy is defined as follows:
  - a. First offense — verbal warning
  - b. Second offense — written warning
  - c. Third offense — suspension (three working days)
  - d. Fourth offense — five day suspension pending discharge
10. *Examining Board* — a joint committee composed of two members designated by the company and two members designated by the union, the purpose of which is to resolve unique situations and cases outside the scope of existing policy or practice.

#### D. POLICY AND PROCEDURE

1. *Chargeable Absence*
  - a. Excessive absenteeism exists when during any calendar month there is more than one chargeable absence occurrence.
  - b. Chargeable absences are inclusive of long absence.
  - c. Disciplinary action will be taken when excessive absenteeism exists according to the progressive disciplinary procedure.
  - d. If, during a 30 (calendar) day period following disciplinary action, there are two chargeable occurrences, the next step of disciplinary action will be initiated.
  - e. For each full, consecutive three (3) month calendar period that an employee has no chargeable absence, the current level of disciplinary action will be reduced one step.



OUTLINE OF INSTRUCTION

2 Remove the cover  
of the power source

3 Unscrew the filter  
jars and clean them.

4 Remove dirty filters  
by unscrewing hollow  
bolt with wrench and  
slip off felts.

5 Wash felts down with  
solvent or replace  
them with new ones.

INSTRUCTOR ACTIVITY

2 Show slides

3 Show slide

4 Show slide

STUDENT ACTIVITY

124

211

210

1-4-8

3086P9

**4. *Miscellaneous***

- a. To be considered valid, all disciplinary action must be issued within five (5) intervening working days of the occurrence.
- b. Occasional absence, long absence and lateness/leaving early are treated separately for disciplinary purposes. Occasions of long absence are included with occasional absence, however.
- c. For purposes of long absence, lateness, and leaving early, all employees have zero (0) occurrences prior to the effective date of this policy.

**E. RESPONSIBILITY**

Each supervisor is responsible for initiating disciplinary action in conformity with this policy subject to review and approval by the Employee Relations Department.

OUTLINE OF INSTRUCTION

(2) Service pump quarterly

(a) Place 4 ounces of solvent into vacuum intake while pump is running.

(b) Catch solvent in a jar at pressure output.

(c) Remove, clean and replace filters and filter jars using procedures set forth in sub-paragraph (10) above.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

212

213

125

**F. LESSON PLAN: JOB ETIQUETTE**

**Unit Objective:** To provide procedures for job acceptance and job termination.

**Performance Objective:** At the end of this unit the student will be able to:

- Draft a letter of resignation according to classroom guidelines.
- State recommended procedure for leaving a job.

**Skills Emphasized:**

- Understanding the importance of proper resignation procedures.

**Materials and Equipment:**

- Letter of resignation format
- Handout on leaving a job

**Activities:**

1. Each student will state the procedure for leaving a job.
2. Each student will draft a letter of resignation.

### OUTLINE OF INSTRUCTION

(3) Pump-check pump vanes

- (a) Replace when  $\frac{1}{8}$  inch remains in rotor at full extension position of vanes or if vanes become nicked or cracked.

NOTE: Follow instructions for General Operating and Maintenance instructions, Sodr-x-tractor SX-300, PACE No, 810-001 when holding any maintenance on the unit.

- (4) Hold daily inspections of all power cords and footswitch cords for any safety hazards to personnel before using unit.

### INSTRUCTOR ACTIVITY

- (3) Show slides on break-down of pump.

### STUDENT ACTIVITY

126

215

214

**ACTIVITY 2: SUGGESTED PROCEDURE FOR LEAVING THE JOB**

Prepare a written resignation

Give present employer at least a two week notice

Discuss your reason for leaving with your supervisor

Be careful; "Don't burn bridges" by making negative comments about your employer

OUTLINE OF INSTRUCTION

b. SX-200 (Extractor Handpiece)

- (1) Remove tip at end of each shift (8 hours of operation)

NOTE: Do not allow tip to remain in element when unit is not in use for extended periods.

- (2) Clean elements, baffle and chamber daily.

- (3) Replace cotton filter whenever dirty.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

6. What advice would you give to the instructor in order to improve her teaching technique? \_\_\_\_\_

---

---

---

7. What will you do differently in job seeking and job survival as a result of this class? \_\_\_\_\_

---

---

---

8. Who would you recommend to take this course? \_\_\_\_\_

---

---

---

9. Overall Evaluation of course.  
Circle your choice:

Very Useful

Useful

Nice to Know

Unnecessary

10. Comments \_\_\_\_\_

---

---

---

---



<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>(4) Check cord/hoses for cuts, burns, cracks, ect.</p> <p>(5) Lubricate chamber and baffle with mineral oil daily to aid in cleaning.</p> <p>(6) Check rubber seals for cracks and for correct position after each cleaning.</p> <p>c. Hot Cubby Unit</p> <p>(1) Clean sponge and platers brush daily.</p>		128

## APPENDIX A: WELCOME TO RACC/TRAC

### Welcome to RACC/TRAC!

RACC/TRAC is a part of the Berks County CETA Program. Our goal is to provide the educational support courses for the CETA Training Program.

Our offices are in room 624. Office hours are:

### *Attendance*

### *Class Hours*

Each person will have a time sheet. You are responsible for recording the following on your time sheets:

- Time arrived in the morning
- Time left for lunch
- Time returned from lunch
- Time left for the day

**YOU WILL BE PAID ACCORDING TO  
THE NUMBER OF HOURS REFLECTED  
ON YOUR TIME SHEET.**

If, because of an emergency, you cannot attend class, you must call the instructor *before* 8:00 a.m. at 372-4721 Ext. 362 or 365.

### *Tardiness*

You are expected to be on time each day. This is your job for the next two weeks. Remember, you will be paid according to your time sheet.

### *Telephone Messages*

Only *emergency* telephone messages will be delivered. Please use the pay telephones in the first floor lobby for your personal telephone calls.

The classroom telephones are for job search telephone calls *only*.

### *Dress Code*

Please dress *for* the position you are seeking.

### *Counseling Services*

Your instructor will be the counselor. Alert your instructor in advance if you desire counseling.

After the Working Class is over, counseling hours will be:

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(2) Add water to sponge as required.

2. Moto Tool - Routine Maintenance.

a. Daily

(1) Check tool body for cracks or loose screws.

(2) Check chuck/collet for wear, stripped threads or cracks.

1-4-13

621.

## To Develop Job Seeking Personal Goals

	<u>YES</u>	<u>NO</u>
Throws the exact number of ring tosses that he or she has pre-determined to throw. (The required distance between the thrower and the target is <u>not</u> given.)	_____	_____
Throws the exact number of ring tosses that he or she has pre-determined to throw. (The required distance between the thrower and the target is prescribed.)	_____	_____
Writes out a definition for a work goal. (The finished product would contrast work goals with other kinds of goals.)	_____	_____
Compares in writing, short and long range goals. (Definition must include contrast of short and long range goals.)	_____	_____
Prepares a written checklist to be used in setting short and long range goals.	_____	_____
Generates and writes out a minimum of three personal work achievable goals. (Two short range work goals and one long range goal.)	_____	_____
Selects a short range work goal, sequences the steps to achieve the goal and provides a projected completion date in writing.	_____	_____
Selects a long range work goal, sequences the steps to achieve the goal, and provides a projected completion date in writing.	_____	_____
Paraphrase in writing, the quote, "If you don't know where you're going, you'll probably end up somewhere else."	_____	_____

225

200

OUTLINE OF INSTRUCTION

- (3) Check cord for burns, cracks and plug integrity.

b. Weekly

- (1) Clean dust from inside housing with low pressure air. (May be done more often if necessary)

- (2) If in heavy use check brushes and armature for wear.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

130

223

222

	<u>YES</u>	<u>NO</u>
Lists two usages of the Chamber of Commerce in a job search.	_____	_____
Lists two usages of the Library in a job search.	_____	_____
<b>To Develop Job Seeking Skills</b>		
Completes designated format for employment history correctly.	_____	_____
Completes personal data, job accomplishments, and employment objective format correctly.	_____	_____
Drafts a resume using format designated in class.	_____	_____
Drafts an introductory cover letter to accompany resumes using guidelines provided in class.	_____	_____
Drafts letter(s) to person(s) to be used as references to secure permission to use their name(s).	_____	_____
Drafts a follow-up letter to be used in a job search.	_____	_____
Drafts a letter to respond to newspaper ads using format provided in class.	_____	_____
Completes a written quiz on the use of resumes, introductory letters, follow-up letters, want-ad letters, and reference letters, with 80% proficiency.	_____	_____

OUTLINE OF INSTRUCTION

3. All other electrical equipment used -  
routine maintenance.

a. Daily checks

(1) Damaged Power cords.

(a) Burns, cracks, breaks

(b) Solvent attack

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1-4-15

225

131

YESNO

Paraphrases the statement, "Dress for the job you are seeking."

\_\_\_\_\_

\_\_\_\_\_

#### To Provide Opportunities to Practice Job Application Skills

Prepares an application data card to be used in completing applications. (Information on this card must be items identified in class.)

\_\_\_\_\_

\_\_\_\_\_

Completes vocabulary quiz on applications with 80% proficiency.

\_\_\_\_\_

\_\_\_\_\_

Completes at least four job applications using application data form as a guide.

\_\_\_\_\_

\_\_\_\_\_

Identifies verbally what form should accompany a resume, and states why.

\_\_\_\_\_

\_\_\_\_\_

Completes the identified form to accompany the resume.

\_\_\_\_\_

\_\_\_\_\_

#### To Evaluate Job Preference and Suitability

Completes a weekly budget and determines minimum wages needed using an established budget format.

\_\_\_\_\_

\_\_\_\_\_

Completes, in writing, a job acceptance criteria form.

\_\_\_\_\_

\_\_\_\_\_

#### To Provide Opportunities to Apply for Jobs in the Current Employment Market

Replies in writing and/or by telephone to at least ten newspaper advertisements using format developed in class.

\_\_\_\_\_

\_\_\_\_\_



OUTLINE OF INSTRUCTION

(2) Insulation damage

(3) Evidence of wear

(4) Dirt

B. SX-300 System - Periodic Maintenance

1. If equipment does not operate check for:

a. Unit plugged in

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

132

227

226

1-4-16

6172P9

## II. Competencies - Job Survival Skills

### To Explore Job Survival Attitudes

	<u>YES</u>	<u>NO</u>
Identifies from a list of terminology, terms which apply to developing a positive job survival attitude.	_____	_____
Identifies from a given list of positive and negative attitude statements, the positive job survival attitude statements.	_____	_____
Lists at least three advantages of displaying a positive job survival attitude.	_____	_____
Writes a factual example of a person displaying a positive job survival attitude.	_____	_____
Revises a negative job survival attitude statement to a positive job survival attitude statement.	_____	_____

### To Develop Job Survival Personal Goals

Writes out a definition for a personal relation goal. (The finished product would contrast work goals with personal relation goals.	_____	_____
Generates and writes out a minimum of three personal relation goals. (Two short range personal relation goals and one long range goal.)	_____	_____
Selects a short range personal relation goal, sequences the steps to achieve the goal and provides projected completion date in writing.	_____	_____

OUTLINE OF INSTRUCTION

b. - Power on

c. Blown fuses

d. Binding pump

2. Frozen or broken extractor tips.

a. Remove frozen/broken tip as follows:

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

133

	<u>YES</u>	<u>NO</u>
Lists the seventeen skills discussed in class that employers seek in an employee.	_____	_____
Selects ten of the above skills and gives an example of these skills in use.	_____	_____
Lists five reasons employees are terminated. (Items must be taken from classroom guidelines.)	_____	_____
Lists five tips for keeping a job. (Tips must be taken from class guidelines.)	_____	_____
Identifies ten tasks that a new employee should accomplish during the first week on a new job.	_____	_____
States a procedure for leaving a job. (Using classroom guidelines.)	_____	_____

### To Identify and Demonstrate a Process for Interpersonal Problem-Solving

Writes a definition of an interpersonal problem.	_____	_____
Lists two potential interpersonal problems people may have.	_____	_____
Identifies appropriate means from a given list of means that includes both appropriate and inappropriate means for a given situation.	_____	_____
Generates a minimum of five distinct means for a given situation.	_____	_____

OUTLINE OF INSTRUCTION

(1) Turn off extractor, allow to cool.

(2) Using #3 12-inch long drill and metal block with 3/16 inch hole, attempt to push tip remains out of element.

(3) If unable to push out, slowly and carefully use drill to drill out tip. (Be careful not to scar inside of element with drill bit.)

3. Plugged extractor element

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

134

231

230

Instructor's Comments:

---

---

---

---

---

---

OUTLINE OF INSTRUCTION

- a. Attempt to push solder out with drill.
- b. Insert copper rod until it touches solder plug. Turn heat to full and allow rod to heat solder. Quickly remove rod and step on footswitch to apply vacuum and pull solder into chamber.
- c. A heavy solder plug may have to be drilled out with steps outlined for broken tips.

4. Insufficient vacuum

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

232

233

135

## APPENDIX D: EMPLOYABILITY PROFILE

Employability Profile - This profile provides an opportunity for self-evaluation of marketable skills and personal characteristics. This information will be helpful when selling yourself to employers.

Name \_\_\_\_\_

I have the following skills: \_\_\_\_\_

---

---

---

---

I am . . . . \_\_\_\_\_

---

---

---

---



OUTLINE OF INSTRUCTION

a. Check for the following:

(1) Blockage of tip or element  
with solder.

(2) Chamber sealed at both ends.

(3) Flow control, valve settings  
correct.

(4) Damaged or disconnected vacuum  
hose.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

136

235

234

**SUGGESTED SPEAKERS**

- Working Class Graduate
- Speaker representing employment area of the majority of the class  
Example: A secretary
- Community college member to explain various educational programs available at the college.
- Supervisor or manager in the area of interest  
Example: A supervisor who has a secretary will explain what is expected of a secretary.
- Makeup Consultant  
Example: How to apply makeup for work.

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

- (5) Cotton filter in chamber packed dirty; too large a piece of cotton.
- (6) Filters and pump dirty, clogged.
- (7) Leaks in pump due to loose screw, ect.
- (8) Check that filter bowls are firmly seated.
- (9) Check that pump vanes move freely and are undamaged.

1-4-21

137

6171P9

236

## Appendix G: Mock Interview

During the class each student participates in at least four interviews with the instructor and student role playing the employer.

Finally, each student is interviewed by a local company personnel representative who agrees to come to the class. This session is video-taped and reviewed with the class.

The goal is to make this session with the personnel representative as realistic as possible; therefore, the personnel representative provides the necessary test, application, and interview evaluation forms. The students are advised to prepare as if they were going on a real interview.

OUTLINE OF INSTRUCTION

(10) Check for proper rotor to housing adjustment.

5. Insufficient heat.

a. Check that extractor plug is firmly in socket.

b. Check fuses for power controls.

c. Check power settings.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

138

239

238

**Appendix I: Tapes – World of Work Tape Series****Title: "On the Job"****Produced by:****Education Design, Inc.  
47 W. 13th Street  
New York, N.Y. 10011  
(212) 255-7900**

OUTLINE OF INSTRUCTION

d. Check heater element for:

(1) Tight connections.

(2) Replace elements if bad -  
follow maintenance instructions manual to the letter.

C. PACE HOT SHOT UNIT

1. Handpieces

a. Keep tips clean

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

240

241

139

## APPENDIX K: PREREQUISITES FOR THIRD WEEK

Name \_\_\_\_\_ Date \_\_\_\_\_

\*Prerequisites for Third Week Activities - Check to Indicate Completed:

- \_\_\_\_\_ 1. Companies I'd Like to Work For & Companies That Might Need My Skills Sheets completed.
- \_\_\_\_\_ 2. Personal Contact List completed.
- \_\_\_\_\_ 3. Drafts of Telephone Dialogue.
- \_\_\_\_\_ 4. Job Criteria Form completed.
- \_\_\_\_\_ 5. Reference Letters completed.
- \_\_\_\_\_ 6. Resume completed and copied.
- \_\_\_\_\_ 7. Personal Data Card completed.
- \_\_\_\_\_ 8. Competencies except this unit.
- \_\_\_\_\_ 9. Five References from Personal Contact List.
- \_\_\_\_\_ 10. Job Search Resource - Problem Solving Quiz completed.

\* This form must be completed and passed into the instructor by the last day of the second week. If this form is not passed in by the specified time, you may not be authorized to work the third week.



### OUTLINE OF INSTRUCTION

h. Keep tip retainer screws tight.

2. No power to HS-20

a. Power cord

b. Switch on

c. Fuse

d. Check temperature control

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

OH

243

242

Interviews (Two hours allowed for each interview)

Name of Company	Position Sought	Time (Started/Finished)

Other

Description	Time (Started/Finished)

Signature \_\_\_\_\_ Total hours/minutes \_\_\_\_\_

\* In order to be paid, this time sheet must be submitted each day during the third week.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>D. Safety Precautions</p> <p>1. Tool</p> <p>a. Clean and store all tools properly.</p> <p>b. Never use excessive force on any tools.</p> <p>c. Use each tool in the manner it was designed to be use.</p>		

OUTLINE OF INSTRUCTION

2. Personal

- a. Beware of burns from hot tools.
- b. When using chemicals beware of skin, eye, and internal contact; avoid excessive inhalation of fumes.
- c. Use common electrical safety precautions to prevent injury.
- d. Wear eye protection when using moto-tool and also use approved safety respirator TC-21c-132 when cutting or grinding on printed circuit boards.

216

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

142

217

OUTLINE OF INSTRUCTION

III. APPLICATION - Job Sheet 1-4-1J

IV. SUMMARY

A. Introduction

1. Nature of summary.

2. Purpose of summary.

B. Directions to students.

INSTRUCTOR ACTIVITY

III. Supervise each student's performance, emphasizing safety

A. Emphasize importance of the summary for the student.

STUDENT ACTIVITY

III. Complete 1-4-1J  
Ask questions if procedures are not clear.

OUTLINE OF INSTRUCTION

1. Questions

2. Notes

C. Recap of lessons

1. Routine Maintenance

2. SX-300 System - Periodic

3. Pace hot shot unit

250

INSTRUCTOR ACTIVITY

C. Emphasize safety

STUDENT ACTIVITY

C. Ask questions if  
material not clear;  
check notes to insure  
accuracy and complete-  
ness.

251

hhl

OUTLINE OF INSTRUCTIONV. INFORMAL TEST

There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application".

VI. ASSIGNMENT - NONEINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

252

1-4-29

253

145

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A100-0034

Lesson Topic 2.1:  
Printed Circuit Board Component Installation and  
Soldering

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 2.0 Hours  
Laboratory - 6.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides YXH-L3-S1 thru YXH-L3-S61

3. Training Aids Equipment

- a. Projector, Slide
- b. Screen, Projection, Standard

4. Text

- a. Student's Guide

5. References

- a. MIL-STD-454D
- b. MIL-C-47256 (I T.)
- c. Vol. 6 of PACE Rework and Repair Technology Series

TERMINAL OBJECTIVES

Supported entirely by this lesson topic:

- 1.0 REPLACE component parts on printed circuit boards using the correct tools and soldering techniques and APPLY the proper conformal coating in accordance with the procedures and to the standards outlined in MIL-STD-454D and MIL-C-47256 (M.I.)

ENABLING OBJECTIVES

When you complete this lesson topic, you will be able to:

- 2.1.1 POSITION components on single and double sided printed circuit boards, using preferred mounting as outlined in MIL-STD-454D.
- 2.1.2 SHAPE component leads for mounting on printed boards without damaging leads or components and meeting all bend specifications as listed in MIL-STD-454D.



- 2.1.3 REPLACE electronic components on printed circuit boards utilizing the proper tools and soldering techniques for high quality printed circuit solder connections following the procedures and to the standards as outlined in MIL-STD-454D.
- 2.1.4. INSPECT printed circuit solder connections on selected boards and DETERMINE that quality and reliability are in accordance with the standards outlined in MIL-STD-454D.
- 2.1.5 IDENTIFY the conformal coating application techniques that should be used on various repaired printed circuit boards. Identification will be in complete agreement with the information contained in MIL-C-47256 (M.I.).

#### CRITERION TEST

Given selected single and double sided printed circuit boards the student will position a minimum of 10 components, shape their leads, install them using the accepted soldering techniques and inspect the completed work to ensure that the quality and reliability are in accordance with standards outlined in MIL-STD-454D.

The student will be required to identify by name the acceptable conformal coating application techniques outlined in MIL-C-47256 (M.I.).

HOMEWORK - NONE

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
I. <u>INTRODUCTION</u>		
A. Contact	A. Introduce self and topic. Provide for students needs:	
	1. Muster	
	2. Comfort	
	3. Visibility and seating	
B Readiness	B. Explain value of subject matter, pointing out where appropriate, its relation- ship to the following:	
257	2-1-3	258

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

1. Accomplishment of daily tasks aboard ship.

2. The necessity of the skills and techniques in repair of printed circuit boards.

3. Personal applications of the knowledge and skills.

4. Seek to motivate. Tell a good tie-in story if possible.

bhl

259

260

2078-79P10

2-1-4

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
C. Effect	<p>C. When following a subject matter lesson topic, do the following:</p> <ol style="list-style-type: none"> <li>1. Explain relationship of this lesson to previous lesson(s).</li> <li>2. Commend students for mastery of skills in previous lesson(s).</li> </ol>	
D. Overview	D. Overview lesson by:	

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

151

1. Stating learning objectives as contained on cover pages to this topic.

2. Stating procedures to be followed during the lesson.

a. Taking notes

b. Asking questions

c. Use of criterion test

264

263

## OUTLINE OF INSTRUCTION

## INSTRUCTOR ACTIVITY

## STUDENT ACTIVITY

### II. PRESENTATION

- A. Proper positioning of a component on a printed circuit board

#### 1. Specifications and standards

- a. In repair, replacement components should always be installed in conformance with the original configuration

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives or procedures if in doubt.

- A. Explain and describe the proper positioning of components on PCB's using the appropriate slides.

### OUTLINE OF INSTRUCTION

b. Component bodies shall be centered between the component lead mounting points whenever design factors permit

c. Correctly mounted components

(1) The flush mounting technique is the preferred method

(2) The component body is centered between the lead mounting points

### INSTRUCTOR ACTIVITY

c. Display slide YXH L3-S2, "Component Installed on Printed Circuit Board"

### STUDENT ACTIVITY

153

268

267

2078-79P10

2-1-8

OUTLINE OF INSTRUCTION

- d. Replacement components shall be mounted so as to make all possible identification markings readable without disturbing the component.
- e. When a series of components are mounted in the same style and direction, they should be placed so that markings on all are readable from a single point (giving due regard to polarity requirements).
- f. Any mounting hardware removed during disassembly shall be replaced when installing new component.

2. Considerations to be made

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY



OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

- a. The following considerations take mandatory precedence over preferred mounting styles when mounting a component

(1) Proper mounting of polarized components

(2) Physical space limitations of original design

- b. When mandatory mounting considerations have been met, preferred configurations should be used whenever possible.

272

OUTLINE OF INSTRUCTION

B. Methods of shaping component leads for mounting on a printed circuit board

1. Specifications and standards

- a. Component leads shall always be straightened and cleaned prior to shaping
- b. Straightening leads using a tool designed for the purpose
- c. Leads may also be straightened by hand using anything that will NOT cut, or scrape the lead

INSTRUCTOR ACTIVITY

B. Explain the proper methods of shaping component leads

- a. Display slide XYH L3-S3, "Straightening Transistor Leads"
- b. Describe use of special tool

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

- d. Leads can be cleaned using a special tool designed for the purpose
- e. Rubber eraser to clean component leads
  - (1) Use an ink-type eraser for this purpose as other type erasers will leave an oily film on the lead
  - (2) After cleaning leads with any method, the final cleaning step should be to wipe the lead thoroughly with solvent to remove particles left by the other cleaning methods

INSTRUCTOR ACTIVITY

- c. Display slide XYH L3-S4, "Using Special Lead Cleaning Tool"
- e. Display slide XYH L3-S5, "Eraser Cleaning of Leads"

STUDENT ACTIVITY

157

276

### OUTLINE OF INSTRUCTION

- f. The minimum distance between the seal, where the lead enters the body of the component, and the start of the lead bend shall be NO LESS than a distance equal the diameter of the lead itself.
- g. The minimum distance between any weld bead on the lead and the start of the lead bend shall be no less than a distance equal to twice the diameter of the lead itself and the bend shall NOT be between the weld bead and the component body
- h. The minimum radius of the bend itself (sharpness of the bend) shall be no less than a distance equal to the diameter of the lead and the bend angle shall be 90 degrees at all times, except when forming special stress relief bends.

### INSTRUCTOR ACTIVITY

- f. Display slide XYH L3-S6, "Lead Bend Placement From Component Lead."
- g. Display slide XYH L3-S7, "Lead Bend Placement From Component Lead Weld Bead"

### STUDENT ACTIVITY

159

OUTLINE OF INSTRUCTION

i. After bending leads, and before inserting component on board, always clean leads with solvent to remove and skin oils and salts present due to finger contact

j. After installing the component on the board, the proper lead termination must be made prior to soldering

(1) Prior to shaping lead termination, excess lead must be cut with a flush-cutting tool to the proper length

(2) On clinched terminations the lead length shall be not less than the diameter of the pad

INSTRUCTOR ACTIVITY

i. Display slide XYH L3-S8, "Component Lead Bend Radius and Angle"

(1) Display slide XYH L3-S9, "Cutting Excess Lead From Termination"

(2) Display slide XYH L3-S10, "Proper Lead Length for Termination"

200

279

### OUTLINE OF INSTRUCTION

- (3) Semiclinched terminations have the same length specifications as full clinches
- (4) All clinched terminations are bent in the direction of the run
- (5) Full clinch terminations must contact the run surface and not overhang any part of the run edge
- (6) The lead length of straight-through terminations shall be not less than one lead diameter and not more than two lead diameters above the board surface

### INSTRUCTOR ACTIVITY

- (3) Explain that lead is cut within specifications shown

### STUDENT ACTIVITY

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

## 2. Recommended tools

- a. The following items are those recommended for use in cleaning, shaping, and cutting component leads

(1) Round nose pliers

(2) Cutting tweezers

(3) Special lead forming tool

(4) Orange wood stick

284

283

# INTRODUCTION TO INDUSTRIAL COOPERATIVE TRAINING

Learning Activity Package

BEST COPY AVAILABLE



## A Guide for Industrial Cooperative Training Programs



U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRO-  
DUCED EXACTLY AS RECEIVED FROM  
THE PERSON OR ORGANIZATION ORIGIN-  
ATING IT. POINTS OF VIEW OR OPINIONS  
STATED DO NOT NECESSARILY REPRESENT  
OFFICIAL NATIONAL INSTITUTE OF  
EDUCATION POSITION OR POLICY.

TRADE AND INDUSTRIAL EDUCATION SERVICE

Division of Program Services  
Vocational and Adult Education  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216  
May, 1980

LAP 1



OUTLINE OF INSTRUCTION

3. Proper shaping techniques

b. The first step in preparing for component installation is to thoroughly clean the circuit board

(1) A different style of pencil eraser can be used to remove light oxides and gold platings

(2) Heavy oxides and thick platings may be removed with mechanical abrasion

(3) Always clean board after abrading and DO NOT let solvent evaporate, wipe it away

INSTRUCTOR ACTIVITY

b. Display slide YXH-L3S11, "Cleaning Board for Component Installation"

(1) Display slide YXH L3-S12, "Pencil Eraser Cleaning"

(2) Display slide YXH L3-S13, "Removing Heavy Oxides"

(3) Display slide YXH L3-S14, "Cleaning After Abrasion"

STUDENT ACTIVITY

285

2-1-16

286

162

INTRODUCTION TO INDUSTRIAL COOPERATIVE TRAINING

Learning Activity Package



For use with  
Industrial Cooperative Training Programs

TRADE AND INDUSTRIAL EDUCATION SERVICE  
Division of Program Services  
Vocational and Adult Education

S. John Davis  
Superintendent of Public Instruction  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216

July 1980

OUTLINE OF INSTRUCTION

- (4) Solvent cleaning may also be done with a brush. Always use a brush which has soft bristles to prevent scratching the conductor surfaces

- c. The next operation in component installation is cleaning and bending the component leads prior to insertion in board

- (1) A nylon rod may be used to bend component leads. Be sure to always hold the component body immobile and bend only the pigtail end of lead with a smooth wiping motion of the finger to prevent stress damage to component

INSTRUCTOR ACTIVITY

- (4) Display slide XYH L3-S15, "Another Solvent Cleaning Method"

- (1) Display slide YXH L3-S16, "Bending Lead With Nylon Rod"

STUDENT ACTIVITY

163

288

## INTRODUCTION

Industrial Cooperative Training (ICT) is a Program designed to provide industrial occupational training experience for high school juniors and seniors at least sixteen years of age. You will attend school one-half of each school day and receive supervised work experience on the job in a trade, technical, or industrial occupation for the other half of the school day. Occupational training is given on the job in manipulative skills, and job-related instruction is given in the high school ICT classroom.

This Learning Activity Package (LAP) will help you to understand the aims of the program and your responsibilities as a student. Industrial Cooperative Training is a three-way cooperative plan. Only through the combined efforts of your employer, your teacher-coordinator, and yourself can you get the most out of the program.

### OUTLINE OF INSTRUCTION

- (2) Methods of using round nose pliers to form 90-degree bends and stress relief loops. Always use EXTREME care not to mash the component lead during this process

- (3) Gripping lead GENTLY with pliers, make the bend in the same manner as with the nylon-rod

- (4) Ensure that component leads have been properly bent. The correct bend position and radius with the component body centered between bends

- (5) Initial step in forming stress relief loops is to make a standard 90-degree bend in the lead

### INSTRUCTOR ACTIVITY

- (2) Display Slide YXH I3-S17, "Using Round Nose Pliers to Bend Leads"

- (3) Display slide YXH I3-S18, "Pliers in Use to Make 90-Degree Bend"

- (4) Display slide YXH I3-S19, "Results of Proper Bending"

- (5) Display slide YXH I3-S20, "Starting to Form Stress Relief Loop With Pliers"

### STUDENT ACTIVITY

(

289

289

164

## PRETEST

Define the following ICT terms.

1. Cooperative training.

---

---

2. Directly related instruction.

---

---

3. General related instruction.

---

---

4. ICT

---

---

5. Sponsor.

---

---

6. Teacher-coordinator.

---

---

7. Training station.

---

---

8. Training plan.

---

---

### OUTLINE OF INSTRUCTION

- (6) To finish the stress relief bend, grip lead just beyond 90-degree bend and wipe pigtail smoothly around plier jaw forming 180-degree loop
- (7) One of the many types of special lead forming tools along with some examples of its capabilities
- (8) The special tool may be used to measure proper component lead spacing. The sliding post must be locked into place with the setscrew after the posts are inserted into the component mounting holes

### INSTRUCTOR ACTIVITY

- (6) Display slide XYH L3-S21, "Finishing Stress Relief Bend"
- (7) Display slide YXH L3-S22, "Special Lead Forming Tool"
- (8) Display slide XYH L3-S23, "Special Tool Used to Measure Lead Spacing"

### STUDENT ACTIVITY

165

293

291  
206B-69P10

2-1-19

Pretest (Continued)

Respond to the following questions:

22. Who may enroll in ICT?

---

23. Who is accepted in the ICT program?

---

24. What is the on-the-job training requirement of VICA?

---

25. How is credit awarded for ICT?

---

26. How much are earnings for ICT students?

---

27. How is ICT placement arranged?

---

28. What is the in-school program?

---

29. What is the school load for an ICT student?

---

30. What are the four main areas of study?

---

31. What is VICA?

---



### OUTLINE OF INSTRUCTION

- (9) The upper forming posts of the tool reflect the measured lead spacing. The component is inserted into the forming posts and leads are wiped firmly against side of post
- (10) Results of correct measuring and bending with the special tool. Note that correct spacing and bending result in parallel leads and no bow to lead between component body and bend
- (11) Use special tool to form stress relief loops after making standard 90-degree bend. Note that loop also provides a longer heat path when soldering and a handy thermal shunt attachment point

### INSTRUCTOR ACTIVITY

- (9) Display slide YXH L3-S24, "Bending Leads to Measured Spacing"
- (10) Display slide YXH L3-S25, "Example of Proper Measuring and Bending"
- (11) Display slide YXH L3-S26, "Forming Stress Relief Loops With Special Tool"

### STUDENT ACTIVITY

Pretest (Continued)

45. \_\_\_\_\_

46. \_\_\_\_\_

Name seven advantages of the ICT program.

47. \_\_\_\_\_

48. \_\_\_\_\_

49. \_\_\_\_\_

50. \_\_\_\_\_

51. \_\_\_\_\_

52. \_\_\_\_\_

53. \_\_\_\_\_

Circle T if the statement is True, F if it is False. If the statement is false explain why in the blank space provided.

T   F   54. A person planning to become a chef in a restaurant would enroll in a distributive education program.

\_\_\_\_\_

T   F   55. All students in trade and industrial education programs are enrolled in ICT.

\_\_\_\_\_

T   F   56. The main reason for enrolling in vocational home economics is to become a better homemaker.

\_\_\_\_\_

T   F   57. Ornamental horticulture can be learned in an agricultural education program.

OUTLINE OF INSTRUCTION

- d. A component with leads properly bent and cleaned which is ready for insertion into a printed circuit board
- e. After bending and inserting component into board, the next step is to properly form the lead termination
- (1) A component with stress relief loops which is properly inserted into board and ready for lead termination forming
- (2) If forming a straight-through termination, the lead is simply cut to proper length with flush-cutting pliers

295

INSTRUCTOR ACTIVITY

- d. Display slide XYH L3-S27, "Component Leads Cleaned After Bending"
- (1) Display slide YXH L3-S28, "Component Ready for Termination Forming"

2-1-21

STUDENT ACTIVITY

296

## LEARNING ACTIVITY A

### TERMS USED IN INDUSTRIAL COOPERATIVE TRAINING

Objective: You will be able to define ten terms used in Industrial Cooperative Training.

Introduction: Following is a list of several common terms used in Industrial Cooperative Training. It is necessary to understand the meaning and use of these terms before proceeding through the other learning activities in the module.

1. Cooperative training is a concept in education where the student, the schools, and local industry work together to provide an occupational training program for the student. Such a program offers part-time on-the-job experience while the student pursues regular school studies.
2. Directly related instruction is that part of the in-school training program concerned with a study of the occupation in which the student is placed.
3. General related instruction is that part of the school program which is concerned with information good for everyone to know regardless of the occupation being pursued.
4. Sponsor (also training sponsor) is the ICT students' supervisor for the on-the-job training part of the program. The sponsor works cooperatively with the teacher-coordinator in developing the student training program.
5. Teacher-coordinator (also coordinator) coordinates in-school experience for students enrolled in the ICT program. The coordinator teaches, develops training plans, places students on the job, and evaluates performance on the job.
6. ICT is the abbreviation for Industrial Cooperative Training, a part-time training program for secondary school students.

### OUTLINE OF INSTRUCTION

- (3) To form a semiclinched termination, grip the lead END with pliers and bend in the direction of a run to a 45-degree angle without pulling on the lead. Then the lead is cut to the proper length
- (4) The improperly mounted component the result of pulling on the lead while bending
- (5) After bending, the lead is cut with flush-cutting pliers, Note that the flush side of the cut is ALWAYS towards the board

### INSTRUCTOR ACTIVITY

- (3) Display slide XYH L3-S29, "Forming Semiclinched Termination"
- (4) Display slide XYH L3-S30, "Results of Improper Bending"
- (5) Display slide YXH L3-S31, "Clipping Component Lead"

### STUDENT ACTIVITY



Terms Used in Industrial Cooperative Training (Continued)

4. Training plan

---

---

5. Teacher coordinator

---

---

6. Directly related instruction

---

---

7. ICT

---

---

8. General related instruction

---

---

9. Cooperative training

---

---

10. VICA

---

---

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

- (6) A lead being bent in preparation of forming a full clinch termination. The bending and cutting process for full clinch leads is the same as for semiclinch leads

- (6) Display slide XYH  
L3-S32, "Forming Full  
Clinched Termination"

- (7) After cutting, the pigtail is fully clinched down to the board surface with a tool which will not cause damage to lead or cause damage to the board if the user slips

- (7) Display slide YXH  
L3-S22, "Poor Method  
of Making Full Clinch"

- (8) The proper method of forming a full clinch using a nylon rod which will not cause any damage to either lead or board

- (8) Display slide YXH  
L3-S34, "Correctly  
Forming Full Clinch"

- (9) A properly formed full clinch lead termination

299

169

309

## What is Industrial Cooperative Training? (Continued)

### PLACEMENT

The teacher coordinator will arrange job interviews in the student's area of interest. Job placement will depend upon your aptitudes, abilities, and interests. Students may enter the program if they are employed in the area and the job and place of employment is approved by the teacher coordinator.

### IN-SCHOOL PROGRAM

In the classroom about fifty percent of your time will be spent studying information which relates to your job in a general way, while the other fifty percent will be spent studying directly-related material. Your employer and teacher coordinator will work with you in providing technical material.

### SCHOOL LOAD

Most students take three or four classes a day when they are enrolled in ICT. Five hours per week are spent in ICT in-school study.

### AREAS OF STUDY

The four main areas you will study in ICT are job skills, technical information, good job attitudes, and consumer information. All of these areas of study are essential to success in life.

### VICA

As an ICT student, you will be expected to become a member of the Vocational Clubs of America (VICA). This is an organization for students in the trade and industrial education programs.



### OUTLINE OF INSTRUCTION

C. Characteristics of high quality printed circuit solder connections

1. Soldered area

a. The area to be soldered on straight-through and clinched terminations

b. Note that soldered area extends beyond cut end of component lead sufficiently to form a fillet

### INSTRUCTOR ACTIVITY

C. Display slide YXH L3-S35, "Finished Full Clinch Termination" and explain the characteristics

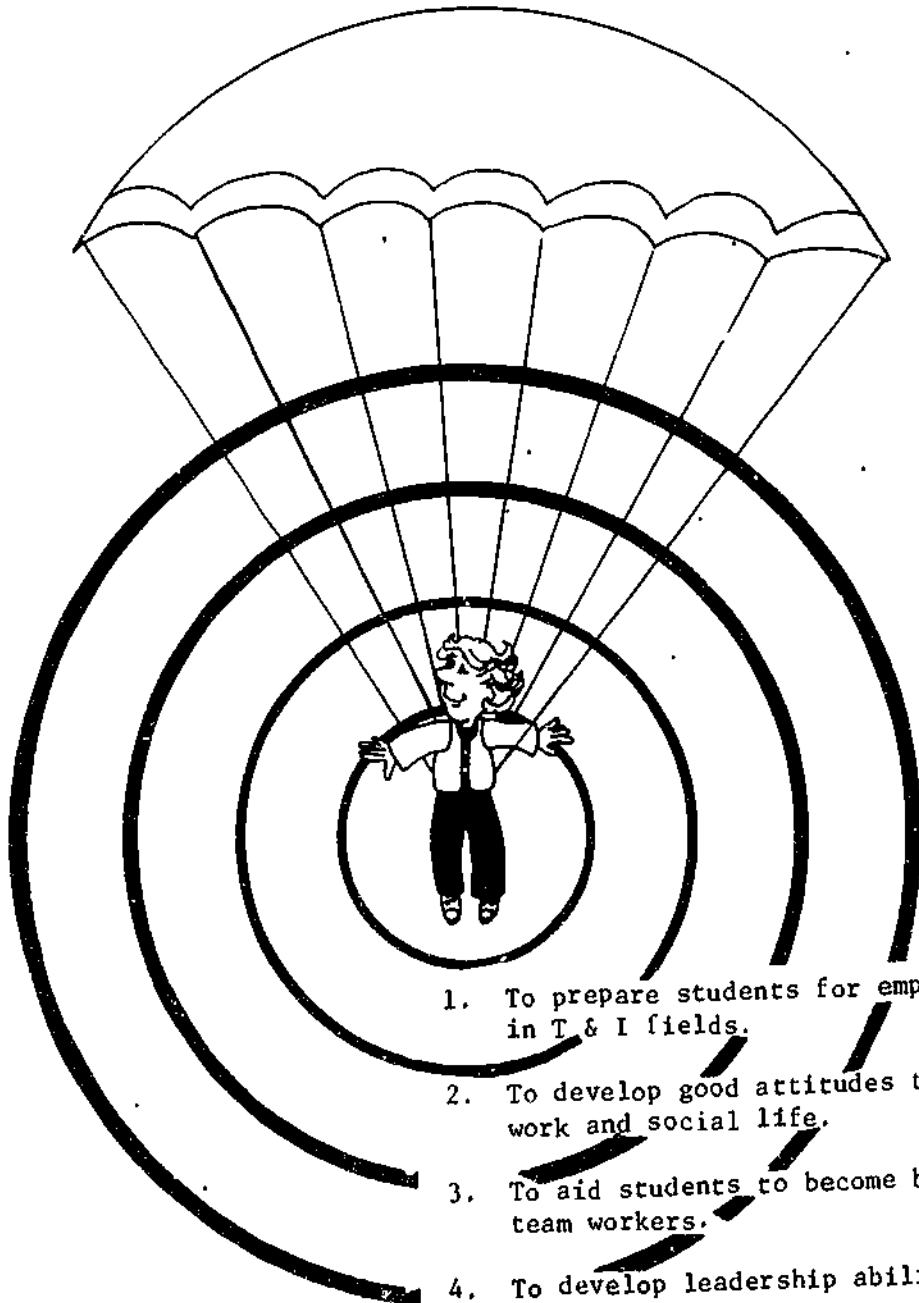
a. Display slide YXH L3-S36, "Area to be Soldered"

### STUDENT ACTIVITY

## LEARNING ACTIVITY C

### AIMS OF INDUSTRIAL COOPERATIVE TRAINING

Objective: You will be able to list five aims of the ICT program.



1. To prepare students for employment in T & I fields.
2. To develop good attitudes toward work and social life.
3. To aid students to become better team workers.
4. To develop leadership abilities.
5. To develop students' awareness of their surroundings.

### OUTLINE OF INSTRUCTION

- c. Solder must flow to the edge of the pad in all cases
- d. If run is plated and plating has been removed, solder shall be flowed over all exposed base metal
- e. The solder forms concave fillets between the lead and pad with no internal voids. Note that the solder does not flow into the hole on single-sided boards
- f. On a double-sided board with plated-through holes or flat-set eyelets, the solder should completely fill the hole and cover pads on both sides of the board

303

### INSTRUCTOR ACTIVITY

- e. Display slide YXH  
L3-S37, "Soldered Area  
on Single-Sided Board"

- f. Display slide XYH  
L3-S38, "Soldered Area  
on Double-Sided Board"

### STUDENT ACTIVITY

171

304

### Aims of Industrial Cooperative Training (Continued)

democracy are important parts of our lives. The ICT program promotes this kind of awareness through participation in the many activities provided in both school and the community.



### OUTLINE OF INSTRUCTION

- g. The soldered area of funnel-set eyelets forms three separate solder joints, one on each side between the outer flanges and the pad, and one through the hole between the inside of the eyelet and the lead

### 2. Solder quantity

- a. Solder quantity falls into four categories: preferred, acceptable, excessive, and insufficient
- b. High quality solder connections will exhibit one of the two following solder quantities

### INSTRUCTOR ACTIVITY

- g. Display slide YXH L3-S39, "Soldered Area of Funnel-Set Eyelets"

### STUDENT ACTIVITY

305

2-1-26

306

172

## LEARNING ACTIVITY D

### YOUR OBLIGATIONS AS AN ICT STUDENT

Objective: You will be able to identify ten obligations as an ICT student.

Introduction: As an ICT student, you will be responsible for conducting yourself in a manner which will reflect positively on you and the ICT program. Your employer will be rating you on certain aspects of your behavior which are just as important in the classroom and at VICA club meetings as they are on the job. The following learning activity should help you to gain insight into your obligations as an ICT student.

1. STUDENTS ARE EXPECTED TO BE REGULAR IN ATTENDANCE AT SCHOOL AND ON THE JOB.

Your employers have agreed to become involved in the program both because they want to provide opportunities for new workers to develop job skills and because they need good employees to do the job. Your work assignment is an important and necessary part of the total operation at your place of employment. If you miss work, someone else must carry your load.

Your on-the-job training is a regular part of the school curriculum--the same as science, math, or English. You receive credit toward graduation for work experience, just as you do for other courses. Your job, your related class, and your other subjects are all vital parts of the design for your entry into the adult world of work. A good record is necessary for continued participation in the program.

2. A STUDENT IS EXPECTED TO BE ON TIME AT SCHOOL AND ON THE JOB.

Punctuality (being on time) is one way of showing that you are ready and able to accept responsibility. Most employers and teachers will judge you partly on your ability to be at the appointed place on time. If, for some unavoidable reason, you must be late, always call your employer.

### OUTLINE OF INSTRUCTION

(1) The preferred solder quantity

(2) An acceptable solder quantity

### 3. Solder finish and wetting

a. The solder finish must exhibit the following characteristics

(1) A smooth gleaming appearance

### INSTRUCTOR ACTIVITY

(1) Display slide YXH L3-S40, "Preferred Solder Quantity"

(2) Display slide YXH L3-S41, "Acceptable Solder Quantity"

### STUDENT ACTIVITY

173

308

307

## Your Obligations As an ICT Student (Continued)

Every place of employment has different requirements, so it will be necessary to look the place over, and determine what is acceptable dress. A good rule is--if you find yourself wearing something which attracts a great deal of attention, it is probably inappropriate. You are expected to perform your job in a responsible manner. You should do your very best at all times. How you conduct yourself will affect your present and future employment opportunities. The fact that you represent the ICT program to your employer will make a difference also in his/her attitude toward hiring other ICT students in the future. If employers have bad experiences with ICT students, they may not be willing to act as training sponsors in the future.

### 7. COMPLETE ALL JOB ASSIGNMENTS CORRECTLY AND PROMPTLY.

First, learn to do the job well, then try to increase your speed. You must remember that training new employees is quite expensive for a business or industry. Because you cannot do the job as well as an experienced employee, the company usually loses money for the first weeks or months of your employment. Employers are willing to spend a certain amount of time and money on training, but they also expect to see progress.

### 8. DO YOUR BEST IN ALL IN-SCHOOL (RELATED) ASSIGNMENTS.

The related class is designed to help you on the job. Try to take advantage of it.

There are certain things which an employee should know which can be better learned in school rather than on the job. Your teacher will be presenting related topics in such areas as pre-employment, taxes, money and banking, and safety. You will also spend a portion of time studying directly



OUTLINE OF INSTRUCTION

(2) No pits or holes

(3) All fillets must be concave

b. Solder wetting characteristics must be as follows

(1) The edges of the solder flow must blend smoothly into the soldered surface with no ridged or bubbled appearance

(2) There must be no bays or crevices extending back into the solder flow

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

## Your Obligations As an ICT Student (Continued)

drifters are not the happiest people. Your teacher-coordinator planned your training station assignment with great care, keeping in mind your particular career goal at the time you entered the program. In most cases it will prove worthwhile to stay with it. If this seems completely impossible, your teacher-coordinator is the person to consult.

12. OBEY ALL TRAFFIC LAWS WHILE TRAVELING TO AND FROM THE TRAINING STATION. FOLLOW YOUR EMPLOYER'S SAFETY CODE.

If you are involved in traffic violations, it eventually could mean that someone else will need to be responsible for getting you to and from your job. Since someone else might not always be available, you may need to give up your job.

While at work, you may think that some of the safety regulations are unnecessary. Obey them anyway. Very often such rules were made because of bad accidents in the past.

13. PARTICIPATE IN YOUR YOUTH ORGANIZATION.

Responsible individuals in a society must function in various roles. Some of these involve individual effort, but others require working effectively with others. Participation in youth groups associated with your program will help you develop group skills and will show you a great deal about organizing and operating an organization.

14. UNDERSTAND THE REASONING FOR YOUR OBLIGATIONS AS AN ICT STUDENT.

The obligations which were discussed include a lot of areas. Please do not view these obligations only as another set of rules, but try to understand the "why" of each of these obligations.

When children are small, it sometimes does not seem worthwhile to explain all the "whys" to them. One tends to say "just because" when they question

### OUTLINE OF INSTRUCTION

#### 0. Techniques for making high quality printed circuit solder connections

##### -1. Application of flux.

- a. Only flux-cored solder should be used as it provides automatic application of flux to the connection while being soldered
- b. For large areas or rapidly oxidizing surfaces, a quantity of external flux may also be applied to the joints prior to soldering

##### 2. Proper heating

311

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

175

312

Your Obligations As an ICT Student (Continued)

WHAT DO YOU THINK?

Look again at the obligations which you have as an ICT student. Then rank the importance of each on the following list by placing a rank order from 1 to 14 in front of each one.

- \_\_\_\_\_ Students are expected to be regular in attendance at school and on the job.
- \_\_\_\_\_ A student is expected to be on time at school and on the job.
- \_\_\_\_\_ Notify your employer when circumstances force you to be absent from work.
- \_\_\_\_\_ Notify your teacher-coordinator when you must be absent from school or work.
- \_\_\_\_\_ In most schools you are not permitted to work on days when you are not in school.
- \_\_\_\_\_ While on the job, you are expected to conduct yourself in a positive and mature manner.
- \_\_\_\_\_ Complete all job assignments correctly and promptly.
- \_\_\_\_\_ Do your best on all in-school (related) assignments.
- \_\_\_\_\_ Avoid detentions, suspensions and expulsions.
- \_\_\_\_\_ Cooperate fully with your teacher-coordinator.
- \_\_\_\_\_ You may not resign or change jobs unless you first discuss the situation with your coordinator.
- \_\_\_\_\_ Obey all traffic laws while traveling to and from the training station. Follow your employer's safety code.
- \_\_\_\_\_ Participate in your youth organization.
- \_\_\_\_\_ Understand the reasoning for your obligations as an ICT student.

OUTLINE OF INSTRUCTION

- a. Proper heating can only be accomplished with a correctly prepared soldering iron -

- (1) A typical soldering iron used in high-reliability soldering. Note the different tip sizes which are used for different masses to be soldered

- (2) The tip being inserted in the iron. The tip should be inserted to bottom of hole and setscrew tightened gently as excessive force will cause screw to heat-seize

INSTRUCTOR ACTIVITY

- (1) Display slide YXH L3-S42, "Typical Soldering Iron"

- (2) Display slide YXH L3-S43, "Inserting Tip"

STUDENT ACTIVITY

## LEARNING ACTIVITY E

### ADVANTAGES OF THE ICT PROGRAM

Objective: You will be able to list seven advantages of the ICT program.

Introduction: Now that you know what ICT is all about it is time to assess the advantages of being in the program. Too often, new students who do not really know the advantages of the program only value the financial gain of being employed while in school. This motive should be considered as one of the least important reasons for being in the program. In this learning activity you will study the nine basic advantages which the ICT program has to offer.

The primary advantages of being in the ICT program are:

1. Study directly and general related subjects in school.

There are certain areas of study which can be learned better in a school situation than on the job. In the directly related areas, for example, related mathematics and blueprint reading require instruction which cannot be given on the job. In the general related areas, such subjects as insurance, consumer decision making, and social awareness could not be taught on the job but are necessary for any worker to know.

2. Permanent employment upon graduation.

As the work world grows more complex, employers seek workers who already have the basic skills. The ICT program offers an opportunity to develop entrance level skills, giving the student a better chance to gain full time employment immediately upon graduation.

3. Earn while you learn.

Employers are expected to pay reasonable learners' wages. If these wages are not as high as you had expected, remember that the employer usually loses money on new employees until they have learned to do the job quickly and accurately.

4. Credit toward graduation while gaining work experience.

You will be awarded credit for the time spent learning a job as you would for taking regular school subjects. The amount of credit offered varies from school to school.

OUTLINE OF INSTRUCTION

(3) A properly dressed copper tip

(a) Copper tips should be dressed with a smooth file only when cold to prevent oxidation and solder repulsion

(b) When using a plated copper tip, never dress the tip with a file. Clad tips should be cleaned only with a plater's brush

INSTRUCTOR ACTIVITY

(3) Display slide YXH L3-S44, "Dressed Copper Tip"

STUDENT ACTIVITY

177

316

315

5085-86P10

2-1-31

### Advantages Of The ICT Program (Continued)

What are advantages of the ICT program?

Fill in the spaces provided with the most appropriate word from the list below.

1. Study \_\_\_\_\_ and general related subjects in class.
2. Permanent \_\_\_\_\_ upon graduation.
3. Earn while you \_\_\_\_\_.
4. Credits toward \_\_\_\_\_ while gaining work experience.
5. \_\_\_\_\_ training under actual work conditions.
6. Bridges gap between \_\_\_\_\_ and \_\_\_\_\_.
7. Helps develop \_\_\_\_\_ personal traits.
8. Student has a chance to find out if a (an) \_\_\_\_\_ suits his/her \_\_\_\_\_ and \_\_\_\_\_.
9. Develop a proper attitude toward \_\_\_\_\_.

learn  
full-time employment  
directly  
aptitudes  
employment  
three  
interests

high school  
occupational  
general  
safety  
desirable  
graduation  
abilities  
occupation



### OUTLINE OF INSTRUCTION

(4) After cleaning or dressing the tip, it MUST be tinned by flowing a generous amount of new solder onto the SHAPED surface as soon as the iron is hot enough to melt solder. The iron is then allowed to idle for approximately 2 minutes until it reaches full operating temperature at which time additional solder is added

(5) The solder is left on the tip if the iron is not going to be used immediately. This protects the hot tip from the rapid oxidizing effects of heat

(6) Before using the soldering iron to make a solder joint, all excess solder must be removed from the tip with a brush or Kimwipe

### INSTRUCTOR ACTIVITY

(4) Display slide YXH L3-S45, "Tinning the Tip"

(6) Display slide YXH L3-S46, "Removing Solder From Tip"

### STUDENT ACTIVITY

## Other Vocational Training Areas (Continued)

### 3. Home Economics.

Most high schools have home economics programs. At one time, home economics was offered mainly to enable young women to become better homemakers. Today, the home economics program has expanded to include training in many occupational fields. Courses now are open to both boys and girls. Many employment opportunities are available. Some of the jobs which come under the home economics category are child care, commercial clothing, commercial food service, and home furnishing.

### 4. Agriculture.

Most rural high schools and some city schools offer courses in vocational agriculture. The field of agriculture has expanded so that farming is no longer such a predominant area. Some other fields in agriculture are agricultural mechanics, ornamental horticulture, conservation, agricultural marketing, and forestry.

### 5. Business.

Vocational programs in business education involve courses and cooperative training programs in business and office occupations. Business education programs train students for careers such as clerks, secretaries, bookkeepers, key punch operators, and data processing technicians.

### 6. Distributive education.

The distributive education program is designed to offer knowledge and skills in marketing, merchandising and management. Some occupational areas are insurance, retailing, real estate, advertising, and display.

OUTLINE OF INSTRUCTION

- (7) If the iron has idled for some time, fresh solder should be added to the tip prior to wiping off excess solder. This ensures that any impurities will flow to the surface of the solder and be removed during the wiping action

- (8) After the excess solder has been wiped off thermal shock on a wet sponge to provide a clean, dry tip for soldering

- (9) A clean, dry, properly tinned tip ready for use. The thin plate (tinning) slows down oxidation and aids in heat transfer to the connection when soldering

INSTRUCTOR ACTIVITY

- (8) Display slide YXH L3-S47, "Thermal Shocking the Tip"

- (9) Display slide YXH L3-S48, "Clean Dry Tip"

STUDENT ACTIVITY

179

320

319

5085-86P10

2-1-33

## LEARNING ACTIVITY 6

### FORMS USED IN ICT

Objective: You will be able to explain the use of three forms used in the ICT program.

Introduction: In any program where many persons are involved there must be regulations, agreements, and reports forms. By studying the various forms used in the ICT program, you will be able to gain a better understanding of the entire program operation than you have now. Study the following seven forms. If you are beginning the ICT program, your teacher-coordinator may ask you to complete the ICT Information form found on page 32.



### OUTLINE OF INSTRUCTION

- b. To achieve proper heating of the connection, the tip size and the wattage of the element must be capable of rapidly heating the mass of the joint being soldered to the melting temperature of solder
  - c. When soldering a small mass connection, the applied heat may be controlled by either decreasing the size of the tip used by decreasing the power to the iron with the variable AC control
3. Application of solder
- a. Before applying heat a thermal shunt should be attached to component leads if dealing with heat sensitive components

### INSTRUCTOR ACTIVITY

- a. Display slide YXH L3-S49, (using thermal shunts)

### STUDENT ACTIVITY

180

FAIRFAX COUNTY PUBLIC SCHOOLS  
INSTRUCTIONAL SERVICES DEPARTMENT  
VOCATIONAL EDUCATION  
COOPERATIVE WORK-TRAINING PROGRAMS

EMPLOYER'S AGREEMENT

Date \_\_\_\_\_

Firm \_\_\_\_\_

Address \_\_\_\_\_ Phone \_\_\_\_\_  
Street City State Zip Code

Student's Name \_\_\_\_\_ Age \_\_\_\_\_

School \_\_\_\_\_ Service \_\_\_\_\_ Phone \_\_\_\_\_

Job Title \_\_\_\_\_ Beginning Wage \_\_\_\_\_

Total Hours of Employment per Week \_\_\_\_\_

Immediate Supervisor \_\_\_\_\_ Title \_\_\_\_\_

Beginning Date \_\_\_\_\_

The business or industrial firm involved agrees to place the work-training student on the above-named job for the purpose of assigning work which has instructional value and will assist the coordinator in evaluating the student's progress.

The salary paid to the work-training student by the employer should be equal to that paid any beginning part-time employee.

The work-training student will receive the same consideration given regular employees in relation to safety, health, company regulations, social security, and general working conditions.

The employer agrees to provide a minimum average of 15 hours of employment per week. However, the maximum work week should not exceed 28 hours.

If the employer desires to make any change in aspects of the job or terminate the agreement because of unsatisfactory job performance, the coordinator should be notified immediately.

\_\_\_\_\_  
Coordinator

\_\_\_\_\_  
Employer's Representative

Your employer may be asked to sign an agreement before you are hired.

### OUTLINE OF INSTRUCTION

- (1) The component leads do not provide access for thermal shunt attachment due to the use of mounting hardware.  
✓ EXTREME care must be used to prevent heat damage in this case. Some heat protection is provided by the mounting hardware and the additional lead length
- (2) A solder bridge is formed by melting a small amount of solder at the junction of the tip and the joint as shown. This forms a large-area, intermetallic bond between the tip and the joint, effectively making the tip a part of the joint and allowing maximum possible heat transfer rate from the tip to joint

### INSTRUCTOR ACTIVITY

- (1) Display slide YXH L2-S51, "Inaccessible Component Leads"
- (2) Display slide YXH L3-S52, "Forming the Heat Bridge"

### STUDENT ACTIVITY

181

324

323

APPLICATION FOR A WORK PERMIT

THIS IS NOT AN EMPLOYMENT CERTIFICATE  
PERMISSION FOR EMPLOYMENT  
(In accordance with Section 40.1-92, Code of Virginia)

Boys and Girls 12 to 16 years of age:

I have personally appeared before the Issuing Officer and give my consent to:

.....  
(Name of minor)  
to be employed at .....  
(Name and address of place of employment)  
Date, ..... Signature .....  
(Parent or Guardian)

Boys and Girls 16 and 17 years of age:

This will serve the Issuing Officer notice that I give my consent for .....  
(Name of minor)

..... to be employed at .....  
(Name and address of place of employment)  
Date, ..... Signature .....  
(Parent or Guardian)

COMMONWEALTH OF VIRGINIA  
DEPARTMENT OF LABOR AND INDUSTRY  
RICHMOND, VIRGINIA

This page and the next two contain copies of the three-part application for work permit. It is printed in three colors. Green, white and pink. It must be completed by your parent, your potential employer and your physician, and returned to the issuing officer in your school.



OUTLINE OF INSTRUCTION

(3) After the prepared tip is placed in physical contact with both the lead and the pad and the heat bridge has been established the solder must be applied to form the solder bond

(a) Use only clean solder

(b) The iron should not be moved during the soldering operation even on double-sided boards since proper cleaning and heating of the joint area will allow the solder to flow through the hole and form the entire joint with a single application (except for holes without reinforcement)

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

Forms Used in ICT (Continued)

Age given by applicant \_\_\_\_\_ Apparent Age \_\_\_\_\_

Remarks \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

This certifies that I have this day examined the above named child and have found \_\_\_\_\_ to be of normal development, in reasonable health, and physically fit to work as \_\_\_\_\_ in \_\_\_\_\_ (Type of business or industry)

Examining Physician \_\_\_\_\_

Address \_\_\_\_\_ Date \_\_\_\_\_

COMMONWEALTH OF VIRGINIA  
DEPARTMENT OF LABOR AND INDUSTRY  
RICHMOND, VIRGINIA

HOURS OF WORK PERMITTED BY LAW

(In Accordance with Section 40-1-30 of the Code of Virginia)

Effective July 1, 1972

Not more than 8 hours in any one day; not more than 40 hours in any one week; not more than 6 days in any one week; not more than 5 consecutive hours of work without at least a 30-minute rest or meal period. Boys and girls 16 and 17 years of age not before 5 a.m., not later than midnight. Boys and girls 14 and 15 years of age not during hours that schools are in session except those certified with work-training, school--part time or provisional types of employment certificates; not before 7 a.m., not later than 6 p.m. except they may be employed as late as 10 p.m. on days not followed by a school day.

Back of application for work permit. Please read the entire permit.

### OUTLINE OF INSTRUCTION

- (c) Solder is applied to the connection by painting the solder onto the area to be soldered using a circular motion. Start by forming fillets along sides of lead and tinning cut end of lead; finish by filling in the large flat area of pad.

#### 4. Cleaning after soldering

- a. After the soldering operation is completed all flux residues must be removed by solvent cleaning
- b. Cleaning with solvent and bristle brush after soldering

### INSTRUCTOR ACTIVITY

- (c) Display slide YXH L3-S53, "Applying Solder to Connection"

- a. Display slide YXH L3-S54, "Cleaning After Soldering"

- b. Display slide YXH L3-S55, "Alternate Cleaning Method"

### STUDENT ACTIVITY

183

328

327

forms used in ICI (Continued) One of your responsibilities is to fill this form out completely and accurately on a daily basis for your coordinator. If you are employed, complete this form and turn it to your coordinator.

### DAILY WORK REPORT

Last Name	First Name
-----------	------------

### Occupation

### Training Station

Month of _____	Number of School Days _____	Actual Hours _____	@ \$ _____	= \$ _____
----------------	-----------------------------	--------------------	------------	------------

[illegible]

OUTLINE OF INSTRUCTION

- c. The flux residue may also be removed using solvent and a Kimwipe as shown
- d. Do NOT allow solvent to air-dry on the board as it will leave a thin layer of flux residue behind.
- e. Many solvents are approved for circuit board cleaning. The four most highly recommended solvents in order of their overall effectiveness are:

(1) 99.5% pure ethyl alcohol

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

## Forms Used in ICT (Continued)

## Evaluation

Quality Control		Quarter				Comment	
		1	3	3	4		
Classwork							
Employer							
Class attendance							
VICA/Special Projects							
Average							
		1	2	3	4		
Work Hours							Total

### Schedule of Occupational Experiences

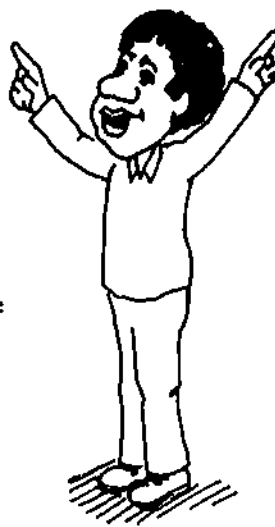
[illegible]

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
(2) 99.5% pure isopropyl alcohol		185
(3)		
(4)		
E. Tools used for component mounting and soldering on printed circuit boards		
1. Handtools		332
a. Orangewood stick		
331		

## Forms Used In ICT (Continued)

Match the type of ICT forms in the right-hand column with its use in the left hand column. Place the identifying letters in the blanks.

- |   |                                |
|---|--------------------------------|
| _____ 1. Form which your parents sign in order for you to be in the ICT program.                                      | A. Employer's Agreement        |
| _____ 2. Form which your parents must sign in order for you to obtain a work permit.                                  | B. Application for Work Permit |
| _____ 3. Form which gives personal information. (To be used in the school).   | C. Industrial Educational Plan |
| _____ 4. Official certificate which allows minors to work.  | D. Daily Work Report           |
| _____ 5. This form is really a contract between the employer and the school.  | E. Information Card            |
| _____ 6. Form in which you keep record of hours worked.   | I. Agreement - Parent/Guardian |
| _____ 7. Form which you complete at the end of the school year, showing all occupational experience and hours worked. | G. Employment Certificate      |





OUTLINE OF INSTRUCTION

- b. Thermal shunts
- c. Flush-cutting pliers
- d. Circuit board holder
- e. Magnifying lamp
- f. Bristle brush
- g. Typewriter eraser (white)

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

508B-89P10

2-1-40

334

186

333

ICT-8 (8/74)

How Will I Be Evaluated? (Continued)

EMPLOYER'S REPORT TO COORDINATOR  
INDUSTRIAL COOPERATIVE TRAINING  
High School

Edna Abbott      Auto Mechanic      Town Motors, Inc.      Jerry Smith  
Name of Student      Occupation      Training Station      Coordinator

Rating Elements	Excellent	Good	Fair	Poor	Additional Remarks
Attitude (conduct, courtesy, etc.)			x		
Cooperation (team worker)				x	Doesn't work well w/ others
Initiative (self-starter)				x	Must be told often
Accepts Responsibility (reliable, etc.)			x		
Loyalty (for Company)		x			
Resourcefulness (good judgment, etc.)			x		
Response to Instruction or Criticism		x			
Interest in Occupational Goal			x		
Progress (knowledge, confidence, etc.)				x	Doesn't seem to know
Quality of Work (accuracy, etc.)				x	
Production (quantity of work)	x				
Practices Safety (with equip., etc.)			x		
Attendance (notification of absence)			x		
Prompt and Ready for Work			x		Late 5 times this month
Personal Appearance	x				

General Remarks:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
Date      Immediate Supervisor      Employer

Additional questions on back for supervisor

Your employer will rate your job performance according to the categories shown above.

OUTLINE OF INSTRUCTION

2. Power tools

a. Soldering iron

b. SX-300

3. Materials

a. 63/37 tin/lead solder

b. Flux

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

187

336

## How Will I Be Evaluated?

This anagram contains many words which describe the way in which your employer will be rating you. The words which are hidden are listed below. You will find them located horizontally, vertically and diagonally in the anagram. Do your best to find all of them. Check each word off as you find it. Think about these words in terms of how you conduct yourself in school and on the job.

P I N T E R E S T I N O C C U P A T I O N A L C O A L E  
R M T T R O I Y R H I E B C L G E F D P A L C O F I D E  
A P A L O Y C R I T L B I C O O P E R A T I O N P U A L  
T R A S T A A Y L B A J K O Y H C O U R T E S Y T E A C  
E O L E R L T E A P P E A R A N C E S Q E D T I N C F O  
A V N U U I T I O P Z R E M L A T Y L U N E T D I T H N  
L E C K L I L T O N R S T E T D L A P X D T R T W I C F  
A C S A F E T Y A R N K E G Y I N I T I A T I V E Y D I  
A F U S R E A D Y O K F G P J R K M O D N R C S M A E D  
M W U T T R N T P I N S T R U C T Z O N C O N D U C T E  
P R O G R E S S N L O A B S E N T O K V E M V T W S B N  
L O L T Z T E A M W O R K E R S G K N O W L E D G E A C  
O S R T P R O M P T R O M P R E S O U R C E F U L B I E  
P T Q G O G O O D J U D G M E N T N S U P E R V I S O R

### CIRCLE EACH WORD

RELIABLE  
INTEREST IN OCCUPATIONAL GOAL  
SAFETY  
APPEARANCE  
PROGRESS  
PROMPT  
ATTENDANCE  
RESPONSE  
GOOD ATTITUDE  
CONDUCT  
COOPERATION  
LOYALTY  
INITIATIVE  
COURTESY

TEAM WORK  
RESOURCEFUL  
GOOD JUDGMENT  
INSTRUCT  
CRITICAL  
KNOWLEDGE  
CONFIDENCE  
QUALITY  
ACCURACY  
ABSENT  
READY  
IMPROVE  
RATE  
SUPERVISOR

OUTLINE OF INSTRUCTION

c. Kimwipes

d. Solvent

F. Inspecting completed printing circuit board  
solder connections for quality

1. Standards of acceptance

a. The solder joint must possess  
the proper quantity of solder

b. The solder finish must show no  
evidence of defects

INSTRUCTOR ACTIVITY

1. Display slide YXH  
[3-S56, "Points to Check  
in Solder Joint Inspection"]

STUDENT ACTIVITY

Posttest (Continued)

9. VICA

---

---

10. Vocational Education.

---

---

Circle T if the statement is True, F if it is False.

- T F 11. You must be at least fourteen years of age in order to enroll in the ICT program.
- T F 12. A student is required to work a minimum of 20 hours per week when enrolled in the ICT program.
- T F 13. It is reasonable to take three to four classes per day in school while enrolled in the ICT program.
- T F 14. There is a minimum wage for student-learners in the ICT program.
- T F 15. The youth group for ICT students is called Vocational Industrial Clubs of America.
- T F 16. About thirty percent of your time will be spent on the job with about seventy percent left for in-school activities.
- T F 17. One of the four basic ICT study areas is "good job attitudes".
- T F 18. A "related instruction" class is taught in the school.
- T F 19. The ICT program assures you of full-time employment upon graduation.
- T F 20. The on-the-job phase of the ICT program also offers credit toward graduation.
- T F 21. Safety is an important part of the ICT program.

- | <u>OUTLINE OF INSTRUCTION</u>               | <u>INSTRUCTOR ACTIVITY</u> | <u>STUDENT ACTIVITY</u> |
|---|----------------------------|-------------------------|
| c. Proper solder wetting action             |                            |                         |
| d. Proper lead termination styles           |                            |                         |
| e. No board, conductor, or component damage |                            |                         |
| 2. Indications to look for                  |                            |                         |
| a. Solder quantity                          |                            |                         |
| (1) Concave fillets                         |                            |                         |

339

189

340

Posttest (Continued)

Name five basic aims of the ICT program

32. Aim 1

---

---

33. Aim 2

---

---

34. Aim 3

---

35. Aim 4

---

---

36. Aim 5

---

---

List ten obligations of ICT students.

37. 

---

38. 

---

39. 

---

40. 

---

41. 

---

42. 

---

43. 

---

44. 

---



OUTLINE OF INSTRUCTION

(2) Lead contour visible

b. Solder finish

(1) Bright gleaming finish

(2) No pits or holes

c. Wetting action

(1) Smooth feathering of all edges

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

Posttest (Continued)

Explain the purposes of the following forms:

58. Employment Certificate

---

---

59. Information Card

---

---

60. Daily Work Report

---

---

Explain five traits on which you will be evaluated by your employer.

61. 

---

62. 

---

63. 

---

64. 

---

65. 

---

OUTLINE OF INSTRUCTION

(2). No bays or crevices in edge of flow

d. Lead termination

(1) Proper length

(2) Proper positioning

(3) Pigtail properly cut

e. Results of using different types of cutting jaws to clip component lead

3.13

INSTRUCTOR ACTIVITY

e. Display slide YXH  
L3-S57, "Types of Cutting  
Jaws"

STUDENT ACTIVITY

161

3.14

## ANSWER KEY - ACTIVITY C

### AIMS OF INDUSTRIAL COOPERATIVE TRAINING

1. Explanations may vary.
2. Model examples of how your life can be improved through ICT.
  1. a. Better chance of getting a full-time job because you are trained already.  
b. You will probably start at a higher rate of pay.
  2. a. Learn good attitudes early in life.  
b. Possible to advance more easily on the job because of having attitudes which employers seek.
  3. a. Learn to work with others on the job.  
b. Learn cooperative team work through VICA activities.
  4. 4. a. Develop abilities in public speaking and parliamentary procedure through VICA.  
b. Develop leadership in the community through ICT sponsored community projects.
  5. a. Develop the confidence to run for a local office.  
b. Gain a feeling for the needs of other persons in the community who are less fortunate than you are.

## ANSWER KEY - ACTIVITY D

### YOUR OBLIGATIONS AS AN ICT STUDENT

Rank order will depend on your own feelings. We all tend to rank higher those things which we understand best.

A TIP: Study again those obligations which you ranked further down the list. Perhaps you need to spend some time thinking about why you scored them further down. Maybe you need to develop a better "why" feeling of those obligations.

OUTLINE OF INSTRUCTION

f. The only acceptable indication is that which shows that flush cutting jaws have been used

g. Board, conductor, and component damage

(1) Overheated board

(2) Conductor delamination

(3) Conductor nicks and scratches

(4) Component installation

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

346

192

Answer Key - Activity H (Continued)

- c. Additional confidence would cause the student to be more out-going and show more initiative to work on his own.
- d. Other poor traits such as being late, bad attendance record and lack of good judgment would make this student a poor risk.

ANAGRAM

P	I	N	T	E	R	E	S	T	I	N	O	C	C	U	P	A	T	I	O	N	A	L	G	O	A	L	E	
R	M	T	T	R	O	L	Y	R	H	I	F	B	C	L	G	E	F	D	P	A	L	C	O	F	I	D	E	
A	P	A	L	O	Y	C	R	I	T	L	B	I	C	O	O	P	E	R	A	T	I	O	N	P	U	A	L	
T	R	A	S	T	A	A	V	L	B	A	J	K	O	Y	H	C	O	U	R	T	E	S	Y	T	E	A	C	
E	O	L	E	R	L	T	E	A	P	P	E	A	R	A	N	C	E	S	Q	E	D	T	I	N	C	F	O	
A	V	N	U	U	L	T	I	O	P	Z	R	E	M	L	A	T	Y	L	U	N	E	L	D	I	T	H	N	
L	E	C	K	L	I	L	T	O	N	R	S	T	E	T	D	L	A	P	X	D	T	R	T	W	I	C	F	
A	C	S	A	F	E	T	Y	A	R	N	K	E	G	Y	I	N	I	T	I	A	T	I	V	E	Y	D	I	
A	F	U	S	R	E	A	D	Y	O	K	F	G	P	J	R	K	M	O	D	N	R	C	S	M	A	E	D	
M	O	U	T	T	R	N	T	E	I	N	S	T	R	U	C	T	Z	O	N	C	O	N	D	U	C	T	E	
P	R	O	G	R	E	S	S	I	N	L	O	A	B	S	E	N	T	O	K	V	E	M	V	T	W	S	B	N
L	O	L	T	Z	T	E	A	M	W	O	R	K	E	R	S	G	K	N	O	W	L	E	D	G	E	A	C	
O	S	R	T	P	R	O	M	P	T	R	O	M	P	R	E	S	O	U	R	C	E	F	U	L	B	I	E	
P	T	Q	G	O	G	O	O	D	J	U	D	G	M	E	N	T	N	S	U	P	E	R	V	I	S	O	R	

OUTLINE OF INSTRUCTION

3. Reasons for rejection .

- a. The top row, from left to right shows the following characteristics

(1) Insufficient solder

(2) Acceptable joint (proper quantity and good wetting)

(3) Poor wetting to lead, and lead cut wrong

INSTRUCTOR ACTIVITY

- a. Display slide YXH L3-S58; "Completed Solder Connections" and point out the defects

STUDENT ACTIVITY

193

348

347

5090-91P10

2-I-47

Pretest - Posttest Answer Key (Continued)

29. Most students take three or four classes a day when they are enrolled in ICT. Five hours per week are spent in ICT in-school study.
30. They are: job skills, technical information, good job attitudes, and consumer information.
31. This is the Vocational Industrial Clubs of America, an organization for students in the trade and industrial education programs.

-----

32. To prepare students for employment in industry.
33. To develop good attitudes toward work and society.
34. To help students to become better team workers.
35. To develop leadership abilities.
36. To develop students' awareness of their surroundings.

-----

37 to 46. Select from the following:

- (1) Students are expected to be regular in attendance at school and on the job.
- (2) Students are expected to be on time at school and on the job.
- (3) Students are expected to notify their employers when circumstances force them to be absent from work.
- (4) Students are expected to notify their teacher-coordinator when they must be absent from school or work.
- (5) In most schools they are not permitted to work on the days when they do not attend school.
- (6) While on the job they are expected to conduct themselves in a mature and positive matter.
- (7) They are expected to complete all their job assignments correctly and promptly.
- (8) They are expected to do their best in all in-school (related) assignments.
- (9) They must avoid detentions, suspensions, and expulsions.
- (11) They are expected to cooperate fully with their teacher-coordinator.
- (12) They may not resign or change their jobs unless they first discuss the situation with the teacher-coordinator.
- (13) They are expected to obey all traffic laws while traveling to and from the training station. They must also follow the employer's safety code.
- (14) They are expected to participate in their youth organization.
- (15) They must try to understand the "why" of all these obligations.

-----

47 to 53. Select from the following:

- (1) Study directly and general related subjects in school.
- (2) Permanent employment upon graduation.
- (3) Earn while you learn.



OUTLINE OF INSTRUCTION

b. The bottom row, from left to right, shows the following defects

(1) Insufficient solder

(2) Poor wetting action (copper showing on end of lead)

(3) Sharp end on lead indicates improper cutting

(4) Disturbed solder, poor wetting, and exposed copper

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

195

OUTLINE OF INSTRUCTION

6. Applying conformal coating to a repaired printed circuit board

1. Preparation

a. All dirt, grease, and other foreign matter must be removed

b. Board thoroughly dried and free of any dampness

2. Application techniques

a. Dipping

351

INSTRUCTOR ACTIVITY

a. Display slide YXH L3-S59, "Applying Conformal Coating"

STUDENT ACTIVITY

352

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
b. Brushing		
c. Spraying		
3. Curing the coating		
a. Never cure any coating below normal room temperature		
b. Follow manufacturer's directions for best results		
H. Final inspection of a repaired printed circuit board		

353

197

- | <u>OUTLINE OF INSTRUCTION</u>  | <u>INSTRUCTOR ACTIVITY</u> | <u>STUDENT ACTIVITY</u> |
|--|----------------------------|-------------------------|
| 1. Standards of acceptance   |                            |                         |
| a. Board restored to original configuration  |                            |                         |
| b. No visible degradation to any part of the assembly                              |                            |                         |
| c. Conformal coating with no voids or imperfections                                |                            |                         |
| 2. Indication of reliability   |                            |                         |
| a. Repair made with same type components and materials as used by the manufacturer |                            |                         |

356

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>b. Repairs made should be nearly indistinguishable by visual inspection unless they distinguish themselves by being of a visibly higher quality than the original work of the manufacturer</p> <p>I. Safety precautions</p> <p>A. Workpiece</p> <p>B. Tool</p> <p>C. Personal</p>	<p>I. Display slide YXH L3-S60, "Safety Precautions" and overview precautions. They are listed in the S/G.</p>	

357

5092P10

2-1-52

358

861

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>III. <u>APPLICATION</u></p> <p>A. Performance Test 1.2.1T</p>	<p>A. Supervise each student's completion of performance test, emphasize safety, and critique each</p>	<p>A. Complet Performance Test 1.2.1T. Ask questions if procedures are not clear.</p>
<p>IV. <u>SUMMARY</u></p> <p>A. Introduction</p> <p>1. Nature of summary</p> <p>2. Purpose of summary</p>	<p>A. Emphasize importance of the summary for the student</p>	<p>360</p>

199

359

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>B. Directions to students</p> <p>1. Questions</p> <p>2. Notes</p> <p>C. Recap of lesson</p>		
<p>V. <u>INFORMAL TEST</u></p> <p>A. There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application"</p>	<p>C. Emphasize safety</p>	<p>C. Ask questions if material is not clear; check notes to insure accuracy and completeness</p>

361

362

200

OUTLINE OF INSTRUCTION

VI. ASSIGNMENT

363

5092P10

INSTRUCTOR ACTIVITY

VI. Provide students with the homework assignment

2-1-55

STUDENT ACTIVITY

VI. Ask questions if the assignment is unclear.  
Complete assignment.

364

201



FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

Lesson Topic 2.2:  
Conformal Coating Removal

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 1.75 Hours  
Laboratory - 3.75 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides

(1) XYH L4-S1 through L4-S23

3. Training Aids Equipment

- a. Projector, Slide
- b. Screen, Projection, Standard

4. Text

- a. Student's Guide

5. References

- a. MIL-STD-454D
- b. MIL-C-47256 (M.I.)
- c. Vol 6, PACE Rework and Repair Technology Series

TERMINAL OBJECTIVE

Supported partially by this lesson topic:

- 2.0 REMOVE conformal coatings from printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.

ENABLING OBJECTIVES

- When you complete this lesson topic, you will be able to:

- 2.2.1 IDENTIFY the basic types of conformal coatings listed in Volume 6 of the PACE Rework and Repair Technology Series and MIL-I-46058C, without error.

- 2.2.2 DETERMINE the proper conformal coating removal method to be used on selected printed circuit boards. Determination will be based on information contained in Volume 6 of the PACE Series.
- 2.2.3 REMOVE various conformal coatings from printed circuit boards using the chemical, heat, and abrasive methods and proper tools necessary as outlined in Volume 6 of the PACE Rework and Repair Technology Series.

#### CRITERION TEST

Given various circuit boards with different conformal coatings, the student will be required to identify the coating on a minimum of three circuit boards without error; determine the proper conformal coating removal method to be used and remove the coating using either the chemical, heat or abrasive methods as outlined on Performance Sheet 2-2-1P with minimum degradation to the boards.

#### HOMEWORK

Read and study Notetaking Sheet 2-2-1N and Information Sheet 2-2-1i.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>I. <u>INTRODUCTION</u></p> <p>A. Contact</p>	<p>A. Introduce self and topic. Provide for students needs:</p> <p>1. Muster</p> <p>2. Comfort</p> <p>3. Visibility and seating.</p>	

393

399

204

OUTLINE OF INSTRUCTION

B. Readiness

370

INSTRUCTOR ACTIVITY

B. Explain value of subject matter, pointing out where appropriate, its relationship to the following:

1. Accomplishment of daily tasks aboard ship.
2. The necessity of the skills and techniques in repair of printed circuit boards.

2-2-4

STUDENT ACTIVITY

205

371

0561-62P1

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

C. Effect

3. Personal applications  
of the knowledge and  
skills.

Seek to motivate. Tell  
a good tie-in story  
if possible.

C. When following a subject  
matter lesson topic, do  
the following:

1. Explain relationship  
of this lesson to  
previous lesson(s).

2-2-5

373

206

0561-62912

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>D. Overview</p> <p>374</p>	<p>2. Commend students for mastery of skills in previous lesson(s).</p> <p>D. Overview lesson by:</p> <p>1. Stating learning objectives as contained on cover pages to this topic.</p> <p>2. Stating procedures to be followed during the lesson.</p> <p>2-2-6</p>	<p>207</p> <p>375</p>

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(a) Taking notes.

(b) Asking questions.

(c) Use of criterion test.

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives on procedures if in doubt.

II. PRESENTATION

A. Characteristics and Recognition of  
Common Conformal Coatings

0561-62P1

376

2-2-7

377

208

OUTLINE OF INSTRUCTION

1. The five basic types

a. Epoxies

b. Acrylic lacquers

c. Polyurethanes

d. Varnishes

378

INSTRUCTOR ACTIVITY

1. Display slide YXH  
L4-S2 and describe  
the five basic types  
of conformal coat-  
ings

STUDENT ACTIVITY

209

379

2-2-8



# VOCATIONAL INDUSTRIAL CLUBS OF AMERICA

## Learning Activity Package



## A BEST COPY AVAILABLE Guide for Industrial Cooperative Training Programs



TRADE AND INDUSTRIAL EDUCATION SERVICE  
Division of Program Services  
Vocational and Adult Education  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216  
May, 1960

U.S. DEPARTMENT OF HEALTH  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

OUTLINE OF INSTRUCTION

e. RTV (Room Temperature Vulcanizing) materials

f. Parylene

2. Methods of identifying type by characteristics

a. Each type of conformal coating has specific characteristics of hardness, heat resistance, adhesion, solvent reaction, texture, and brittleness.

INSTRUCTOR ACTIVITY

2. Explain the various characteristics of conformal coatings.

STUDENT ACTIVITY

VOCATIONAL INDUSTRIAL CLUBS OF AMERICA

Learning Activity Package



For use with  
Industrial Cooperative Training Programs

TRADE AND INDUSTRIAL EDUCATION SERVICE  
Division of Program Services  
Vocational and Adult Education

S. John Davis  
Superintendent of Public Instruction  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216

May 1980

NOV 17 1980

OUTLINE OF INSTRUCTION

(1) In addition, coating are classed as being either thick or thin

(2) The difference between thick and thin coatings

(3) A thin coating is considered to be 0.025 inch or less in thickness

b. Individual characteristics may overlap or appear the same; however, overall characteristics evaluation will determine the conformal coating type

382

INSTRUCTOR ACTIVITY

(1) Display slide YXH 14-S3

(2) Point this out to students

STUDENT ACTIVITY

211

383

## INTRODUCTION

The purpose of this Learning Activity Package (LAP) is to inform you about your student organization, the Vocational Industrial Clubs of America (VICA). Your participation as a student in the Industrial Cooperative Training Program permits you to join a vocational education student organization which offers many interesting activities during the school year. This LAP will provide you with background information concerning your organization as well as explain the various programs within VICA. In addition, this LAP will cover the role of a student in the VICA organization.

### OUTLINE OF INSTRUCTION

c. Epoxy coatings have the following characteristics

(1) Epoxy is normally the hardest of the five types of conformal coatings

(2) The application of heat at or near solder melting temperatures causes the epoxy to overcure, resulting in breakdown into a powdery substance

(3) Epoxy forms the strongest surface adhesion bond of all of the conformal coatings. It will not chip or peel and may be considered nearly unbreakable under physical stresses

### INSTRUCTOR ACTIVITY

(1) Display slide YXH L4-S4, pass sample of epoxy around class.

### STUDENT ACTIVITY

## PRETEST

Part I: Circle T if the statement is True, F if it is False.

- T F 1. The Vocational Industrial Clubs of America was started in January 1936.
- T F 2. VICA is an organization for students enrolled in trade, industrial and technical courses.
- T F 3. VICA membership is limited to high school juniors and seniors.
- T F 4. The VICA organization is divided into four divisions and associations.
- T F 5. VICA now has over 250,000 members.
- T F 6. "Vocational Training for Tomorrow" is VICA's motto.
- T F 7. Red, white, blue and gold are the official colors of VICA.
- T F 8. The individual is the most important element of VICA and is represented by the color gold.
- T F 9. The colors red and white represent the individual states and clubs
- T F 10. The color blue represents VICA's belief in the American Way of Life.
- T F 11. The word "ardent" means eager.
- T F 12. The orbital circles in VICA's emblem represent America's industrial society.
- T F 13. VICA members entering the United States Skill Olympics may compete in either skill or leadership events.
- T F 14. VICA competition is held annually at local, district, state, national and international levels.
- T F 15. The United States Skill Olympics was organized to provide recognition to VICA members and to develop togetherness as you work with fellow members on team events.
- T F 16. The Vocational Initiative and Club Achievement Program is a self-paced program designed for individual study.
- T F 17. The American VICA degree is the top award in the Vocational Initiative and Club Achievement Program.

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

213

- (4) Very few solvents will attack epoxy, and the ones that do will also attack the components and circuit boards themselves in most cases. Therefore, solvent testing and removal of epoxy coating is NOT a recommended procedure and should be avoided.

- (5) Texture of epoxy is normally hard, smooth and nonporous, much as an extremely hard plastic

- (6) Epoxy is normally very brittle, but due to its great adhesion strength, it does not chip or crack without the application of extreme stress

357

386



Pretest (Continued)

Part IV. Fill in the blanks with the words which will complete the VICA pledge.

Upon My (30) \_\_\_\_\_, I Pledge

- To prepare (31) \_\_\_\_\_ by diligent (32) \_\_\_\_\_ and ardent practice to become a worker whose (33) \_\_\_\_\_ will be recognized as honorable by my employer and (34) \_\_\_\_\_ workers,
- To base my (35) \_\_\_\_\_ of reward upon the solid (36) \_\_\_\_\_ of service,
- To (37) \_\_\_\_\_ and respect my (38) \_\_\_\_\_ in such a way as to bring (39) \_\_\_\_\_ to myself,
- And further, to spare no (40) \_\_\_\_\_ in upholding the (41) \_\_\_\_\_ of the Vocational Industrial (42) \_\_\_\_\_ of America.

Part V. Match the parts of the VICA emblem listed in the left hand column with the correct words they represent.

- |                              |                    |
|------------------------------|--------------------|
| _____ 43. Industrial society | A. Eagle           |
| _____ 44. Knowledge          | B. Gear            |
| _____ 45. Patriotism         | C. Hammer          |
| _____ 46. Technology         | D. Hands           |
| _____ 47. Youth              | E. Orbital Circles |
|                              | F. People          |
|                              | G. Shield          |
|                              | H. Torch           |

Part VI. List seven of the eleven purposes of VICA.

- 48. \_\_\_\_\_
- 49. \_\_\_\_\_
- 50. \_\_\_\_\_
- 51. \_\_\_\_\_
- 52. \_\_\_\_\_
- 53. \_\_\_\_\_
- 54. \_\_\_\_\_

### OUTLINE OF INSTRUCTION

d. Acrylic lacquers have the following characteristics

(1) Acrylics are relatively hard and similar in appearance to epoxies, but they yield more readily to scraping and cutting

(2) Heat readily softens most acrylics; however, it often results in a gummy residue

(3) The adhesion of acrylics is usually a surface bond only and will often chip and flake, although it is relatively strong

### INSTRUCTOR ACTIVITY

d. Display slide YXH L4-S5, pass sample around class

### STUDENT ACTIVITY

## LEARNING ACTIVITY A

### WHAT IS VICA?

Objective: You will be able to provide background information about VICA which includes the following:

1. Official beginning date and place
2. Membership figures
3. Seven purposes of VICA
4. Four divisions and associations of VICA

Introduction: To be a successful member of any organization, you should know certain background information about the organization. It is the intent of this learning activity to provide you with historical information and the purposes of VICA.



### OUTLINE OF INSTRUCTION

- (4) Solvents, such as 1-1-1 trichloroethane and xylene readily attack and soften most acrylics
- (5) Texture of acrylics is normally smooth, nonporous, and of medium hardness with a glossy finish similar to automotive lacquer paints
- (6) Acrylics are quite brittle and chip readily, but due to their brittleness do not exhibit a tendency to peel in large flakes

e. Polyurethane coatings have the following characteristics

### INSTRUCTOR ACTIVITY

e. Display slide YXH-L4-S6

### STUDENT ACTIVITY

215

391

What is VICA? (Continued)

Like all organizations, VICA was established to fulfill certain purposes. . Below you will find eleven purposes for this student organization for trade, industrial, and technical education.

- . To unite in a common bond all students enrolled in trade, industrial and technical education.
- . To develop leadership abilities through participation in educational, vocational, civic, recreational, and social services.
- . To foster a deep respect for the DIGNITY OF WORK.
- . To assist students in establishing realistic vocational goals.
- . To help students attain a purposeful life.
- . To create enthusiasm for learning.
- . To promote high standards in trade ethics, workmanship, scholarship, and safety.
- . To develop the ability of students to plan together, organize, and carry out worthy activities and projects through use of the democratic process.
- . To foster a wholesome understanding of the functions of labor and management organizations and a recognition of their mutual interdependence.
- . To create among students, faculty members, patrons of the school and persons in business and labor a sincere interest in and esteem for trade, industrial and technical education.
- . To develop patriotism through a knowledge of our Nation's heritage and the practice of DEMOCRACY.

VICA Leadership Handbook, page 62

OUTLINE OF INSTRUCTION

- (1) Polyurethane coatings are found with widely varying degrees of hardness which range from an extremely hard type, which is similar to epoxy, to a relatively soft consistency which is similar to an RTV compound
- (2) Upon application of heat, most polyurethanes tend to soften rapidly and become easily pliable exhibiting a putty-like consistency
- (3) Polyurethanes normally form a medium-strength surface bond which has a tendency to peel or flake in larger pieces than acrylics

INSTRUCTOR ACTIVITY

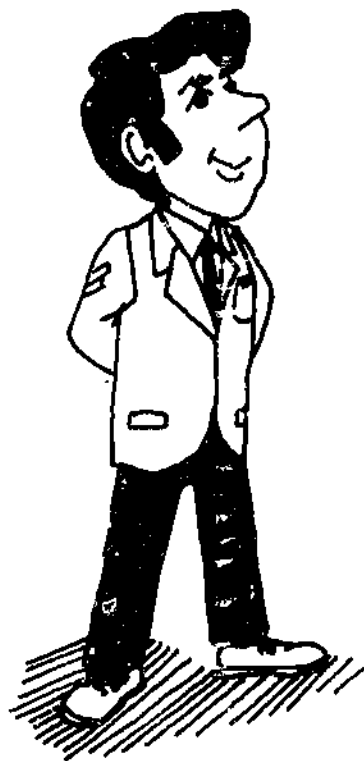
STUDENT ACTIVITY

LEARNING ACTIVITY B  
SYMBOLISM OF YOUR ORGANIZATION

Objective: You will be able identify and explain the following:

1. The six parts of the emblem and the meaning of each part
2. The six parts of the creed and the meaning of each part
3. The four colors of the organization and the meaning of each color.
4. The motto
5. The pledge

Introduction: Like most organizations, the Vocational Industrial Clubs of America has a certain amount of symbolism which is unique to the organization. Throughout the school year you will be exposed to the VICA emblem, creed, colors, motto and pledge. The purpose of this LAP is to explain the meaning of each symbol. In addition, the information presented in this LAP will help you to earn the Citizen Degree of the Vocational Initiative and Club Achievement Program, explained in Learning Activity C.



OUTLINE OF INSTRUCTION

- (4) Plastic solvents are generally the only type solvents that will attack polyurethane coatings; however, these solvents also readily attack many electronic components
- (5) The texture of polyurethanes is usually smooth, glossy, and nonporous, but may be dented or scratched with light pressure such as a fingernail
- (6) Polyurethanes are not brittle and bend readily causing them to tear or stretch rather than crack or break

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

217

395



## Symbolism of Your Organization (Continued)

### The Gear Represents the Industrial Society

The gear, symbolic of the industrial society, denotes the interdependence and cooperation of the individual working together with labor and management for the betterment of mankind.



### The Hands Represent Youth



The hands portray a search for knowledge and the desire to acquire a skill. In the process to attain knowledge and skill the individual will develop a respect for the dignity of work and become a productive and responsible citizen.

### VICA

All of the components comprise our emblem. Separately they could be applied to many organizations, but as one unit they represent the fundamental principles and purposes of our organization. The emblem represents the Vocational Industrial Clubs of America.



VICA Leadership Handbook, pp. 63 & 98.

### OUTLINE OF INSTRUCTION

f. Varnish coatings have the following characteristics

- (1) Hardness of varnishes will vary with age; new varnish is relatively hard and tough while old varnish tends to be brittle and flake off very easily
- (2) When heat is applied to varnish, it liquifies and gives off a very strong and distinctive odor of linseed oil
- (3) The adhesion of varnish coating tends to be a surface bond that will peel readily but cracks often

### INSTRUCTOR ACTIVITY

- (1) Display slide YXH L4-S7

### STUDENT ACTIVITY

I BELIEVE IN EDUCATION

I shall endeavor to make the best use of knowledge, skills, and experience that I learn in school in order that I may become a better worker in my chosen occupation and a better citizen in my community. To this end I will continue my learning both in and out of school.

I BELIEVE SATISFACTION IS ACHIEVED BY GOOD WORK

I feel that compensation and personal satisfaction received for any work and services will be in proportion to my creative and productive ability.

OUTLINE OF INSTRUCTION

(4) Organic solvents such as alcohol and mineral spirits readily attack varnish coatings. However, these solvents leave a gummy residue on the varnish upon evaporation

(5) The surface texture of varnish is often rather lumpy in appearance and has a semiglossy appearance

(6) Varnish is relatively brittle therefore it flakes rather than peels

g. RTV coatings have the following characteristics

INSTRUCTOR ACTIVITY

g. Display Slide YXH  
L4-S8

STUDENT ACTIVITY

219

399

## Symbolism of Your Organization (Continued)

### THE VICA COLORS

Earlier in this learning activity you studied the six parts of VICA's emblem. Let's now take a different view of the emblem. Look around your classroom for the emblem that is presented in color. You will notice that the emblem contains four colors--red, white, blue and gold. Below, the meaning of the VICA colors are explained.

#### Colors

Red, White, Blue and Gold

National Organization of  
Vocational Industrial  
Clubs of America

Red and White

The Individual States and  
Clubs

Blue

The Common Union of the  
States and of the Clubs

Gold

The Individual, the Most  
Important Element of the  
Organization

Leadership Handbook p. 64



### OUTLINE OF INSTRUCTION

- (1) RTVs have a rubbery, pliable consistency
- (2) Heat, except in excessive amounts or for long durations, has little effect on most RTVs
- (3) RTVs will be found to have a wide variety of adhesion strengths which range from readily peelable to extremely tightly bonded to the coated surface
- (4) Common solvents have no appreciable effect on RTV coatings although some may cause the surface to feel as if it has been greased with a slick lubricant

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

## Symbolism of Your Organization (Continued)

### THE VICA PLEDGE

A pledge serves as a promise that a member makes to an organization. Review the VICA pledge given below. Is this a promise you can make to yourself and to your fellow members?

#### UPON MY HONOR, I PLEDGE

- . To prepare myself by diligent study and ardent practice to become a worker whose services will be recognized as honorable by my employer and fellow workers.
- . To base my expectations of reward upon the solid foundation of service.
- . To honor and respect my vocation in such a way as to bring reputé to myself.
- . And further, to spare no effort in upholding the ideals of the VOCATIONAL INDUSTRIAL CLUBS OF AMERICA.

Leadership Handbook, p. 64



OUTLINE OF INSTRUCTION

(5) The texture of RTV is smooth, dull and rubbery

(6) RTVs are not at all brittle and stretch rather than chip, crack or break

h. - Parylene coatings have the following characteristics

(1) Parylene is considered to be a hard coating, and is normally as hard as epoxy.

INSTRUCTOR ACTIVITY

h. Show slide and pass board around class

STUDENT ACTIVITY

221

403

402



## Symbolism of Your Organization (Continued)

### ACROSS

1. I believe satisfaction is \_\_\_\_\_ by good work.
5. Red and white represent the individual \_\_\_\_\_.
9. One of the official colors.
11. The gear is part of the \_\_\_\_\_.
13. The most important element of the organization.
14. The hands represent \_\_\_\_\_.
18. I believe in high \_\_\_\_\_.
19. The \_\_\_\_\_ represents knowledge.
20. To spare no effort in upholding the \_\_\_\_\_ of the Vocational Industrial Clubs of America.
23. Type of study mentioned in pledge.
24. Brief statement of beliefs.
25. I believe in \_\_\_\_\_ moral and spiritual standards.
27. I believe in \_\_\_\_\_.
30. To base my expectations of \_\_\_\_\_ upon the solid foundation of service.
32. The orbital circles represent \_\_\_\_\_.
35. Red, white, blue and gold represent the \_\_\_\_\_ organization of VICA.
36. The \_\_\_\_\_ circles represent technology.
37. VICA's motto is \_\_\_\_\_ in the world of work.

### DOWN

1. I believe in the \_\_\_\_\_ Way of Life.
2. The \_\_\_\_\_ represent youth.
3. The letters on the emblem.
4. I believe in the \_\_\_\_\_ of work.
5. I believe in high moral and \_\_\_\_\_.
6. The common union of the states and of the clubs is represented by the color \_\_\_\_\_.
7. The gear represents the \_\_\_\_\_.
8. To base my expectations of reward upon the solid foundation of \_\_\_\_\_.
10. To \_\_\_\_\_ and respect my vocation in such a way as to bring repute to myself.
12. The \_\_\_\_\_ represents patriotism.
15. The \_\_\_\_\_ represents knowledge.
16. The color \_\_\_\_\_ represents the individual.
17. The shield represents \_\_\_\_\_.
21. I believe in \_\_\_\_\_.
22. ...whose services will be recognized as honorable by my employer and \_\_\_\_\_ workers.
26. Saying what expresses an organization's aims, ideals, or guiding rule.
28. Type of practice mentioned in pledge.
29. . . . , to spare no \_\_\_\_\_ in upholding the ideals of VICA.
31. One of VICA's official colors.
33. The \_\_\_\_\_ represents the industrial society.
34. Blue represents the common \_\_\_\_\_ of the states and of the clubs.

OUTLINE OF INSTRUCTION

- (2) Heat, approximately 480-500°, applied with a hot knife will remove parylene; however the chance of damage to the board is very high at this temperature.
- (3) The adhesion of parylene provides a tough pinhole free coating of uniform thickness that is very tightly bonded to the coated surface
- (4) Parylene has no reaction to normal solvents
- (5) The texture is smooth and dull, and normally clear

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

The Vocational Initiative and Club Achievement Program

The Vocational Initiative and Club Achievement Program, sometimes called "Achievement Program," is designed to provide you with an opportunity to gain individual recognition. You will be permitted to earn awards while working at your own pace.

Your participation in the achievement program will result in several personal benefits. Among these are:

- . An opportunity to earn recognition for achievement.
- . Encourage excellence in skill training and leadership abilities.

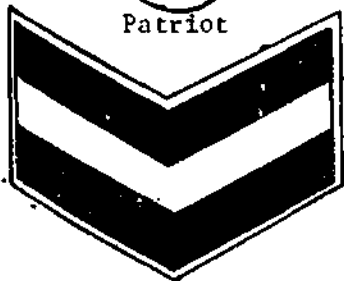
The achievement program is divided into two areas of training with several ranks and degrees.



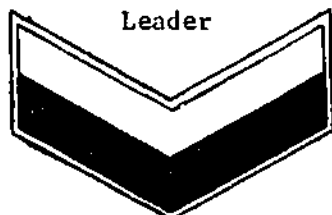
VICA LEADER DEGREE



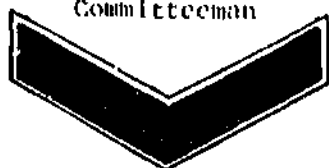
Patriot



Leader



Committeeman



Citizen

One area of development is LEADERSHIP. There are four ranks to be completed in order for a member to earn all four awards in this area. Starting with the lowest rank the awards are:

Citizen  
Committeeman  
Leader  
Patriot

When you have completed the patriot rank you have qualified for the top leadership degree:

THE VICA LEADERSHIP DEGREE

Suggested guidelines for requirements of each rank are contained in the Achievement Program Guide. Your successful completion of learning activity B will qualify you for most of the requirements for the citizen degree. Ask your advisor for more information on how to earn the award.

OUTLINE OF INSTRUCTION

- (6) Parylene is not brittle at all, and bends very easily

B. Coating removal area

1. Areas from which the conformal coating MUST be removed in preparation for component removal from the circuit board

2. These areas are as follows:

INSTRUCTOR ACTIVITY

- B. Display slide YXH L4-S9, and describe the areas.

STUDENT ACTIVITY

223

407

406

## I'm in VICA - Now What? (Continued)

The highest honor in the Vocational Initiative and Club Achievement Program which the Virginia VICA Association may award a member at its annual state convention is the



### THE AMERICAN VICA DEGREE

### AMERICAN VICA DEGREE

To earn this degree you must have (1) successfully completed all requirements for the VICA Leader Degree and the VICA Industrial Degree, and (2) successfully passed a review examination for those requirements.

The highest honor in the Achievement Program is the

### INTERNATIONAL INDUSTRIAL DEGREE

This degree may be achieved only after having earned the American VICA Degree and having entered full-time employment. The members who do complete the requirements for this degree will receive their award at the annual National VICA Convention.



### INTERNATIONAL INDUSTRIAL DEGREE

### Virginia and United States Skill Olympics

The Virginia and United States Skill Olympics is a type of competition which provides VICA members with the opportunity to demonstrate the skills and abilities which they have acquired through their vocational training program. Your participation in the competition will result in several benefits. Among these are:

- . Recognition of your skills and abilities.
- . Development of togetherness as you work with fellow VICA members on team events.
- . Personal enrichment through developing enthusiasm for learning and a sense of accomplishment.
- . Publicity for you and your school.

Competition is conducted in two areas--Leadership Skills and Occupational Skills. The national level competition consists of eight Leadership contests and twenty-eight Skill contests. At the state level it is possible to participate in all national contest categories plus ten additional Leadership events and two additional Skill contests.

OUTLINE OF INSTRUCTION

- a. Remove the coating from all lead/pad areas on both sides of the board. This will allow for free airflow through the mounting holes during desoldering of the leads
- b. Remove the coating along all sides of the component at a point ON OR BELOW the widest profile of the body

C. Methods of removing conformal coatings

1. Chemical removal

INSTRUCTOR ACTIVITY

- C. Display slide YXH L4-S10, and explain the various methods

STUDENT ACTIVITY

I'm in VICA - Now What? (Continued)

### SCRAMBLED WORDS

Unscramble the letters on the left to form words used in learning Activity C.

C A R K I N B I G Y L

N I C E H M A O S H P

R A T C A P C I L U S N E R

G O T C O O L M E S Y

--- C C ---  
--- O O ---  
--- O O O O ---  
--- O O O O ---

Arrange the circled letters to form an important term of learning Activity C.

-----

Unscramble the letters on the left to form words used in learning Activity C.

H E A D R E S L I P G I N N R T A I

M E E T T I N M C O M N A K R

C A I V A R I C E M A N G E E D E R

S A L T I P C I E S K A R N

--- O --- O ---  
--- O O --- O O ---  
--- O O O ---  
--- O --- O ---  
--- O O O ---  
--- O O O ---

Arrange the circled letters to form an important term of learning Activity C.

-----

OUTLINE OF INSTRUCTION

- a. Chemical removal consists of the removal of coatings using solvents
  
- b. The only coating which is readily removable with solvents is acrylic lacquer applied in a relatively thin coating (less than 0.025 inch is considered a thin coating)
  
- c. Chemical removal procedures consist of the following
  - (1) Apply the chemical solvent sparingly

410.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

225

411



Posttest (Continued)

Part II. List two advantages of participating in the Vocational Initiative and Club Achievement Program.

18. \_\_\_\_\_

19. \_\_\_\_\_

List the four associations and/or divisions of VICA

20. \_\_\_\_\_

21. \_\_\_\_\_

22. \_\_\_\_\_

23. \_\_\_\_\_

Part III. List the six points of the creed. In the space following, give a one sentence statement explaining each point of the creed.

24. I believe \_\_\_\_\_. This means \_\_\_\_\_

25. I believe \_\_\_\_\_. This means \_\_\_\_\_

26. I believe \_\_\_\_\_. This means \_\_\_\_\_

27. I believe \_\_\_\_\_. This means \_\_\_\_\_

28. I believe \_\_\_\_\_. This means \_\_\_\_\_

29. I believe \_\_\_\_\_. This means \_\_\_\_\_

OUTLINE OF INSTRUCTION

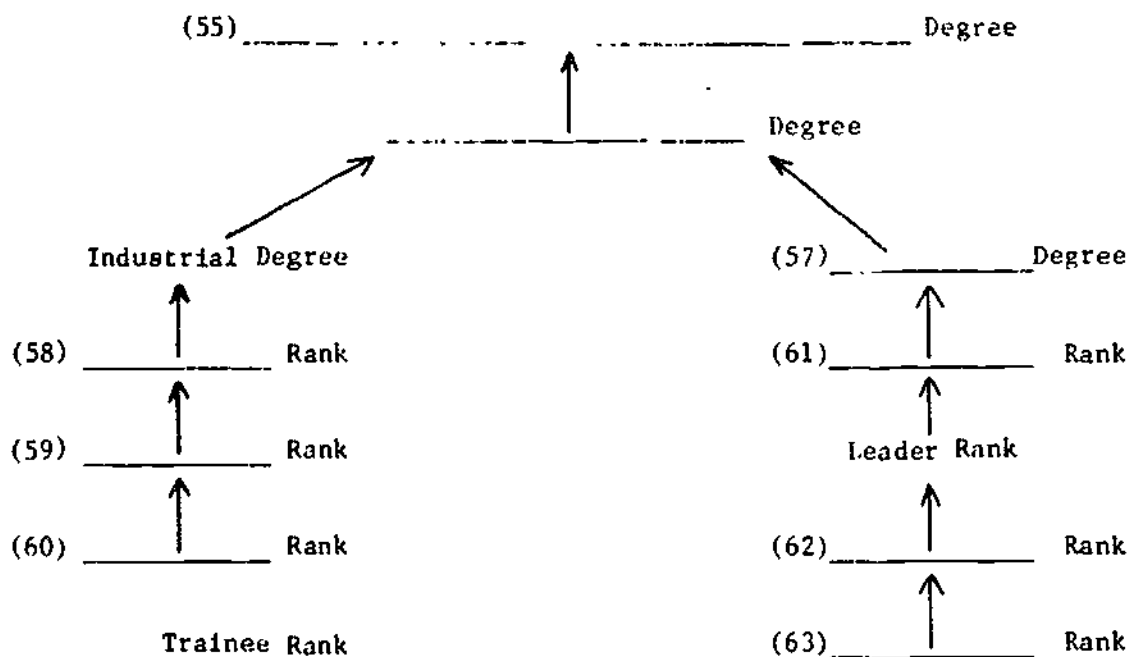
- (2) Apply the solvent only to the area from which the coating must be removed
- (3) For best results the solvent should be applied with a small brush or swab
- ( 4) Solvent should be blotted up continuously to prevent its spreading into undesired areas and to allow new solvent to attack newly exposed lower areas of the coating

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

Posttest (Continued)

Part VII. Below is a diagram representing the degrees and ranks of the Vocational Initiative and Club Achievement Program. Fill in the blanks provided to complete the diagram.



Part VIII. The United States and Virginia Skill Olympics offer competition in both leadership and skill events. Give five examples of each type of competition.

Leadership Events

64. \_\_\_\_\_
65. \_\_\_\_\_
66. \_\_\_\_\_
67. \_\_\_\_\_
68. \_\_\_\_\_

Skill Events

69. \_\_\_\_\_
70. \_\_\_\_\_
71. \_\_\_\_\_
72. \_\_\_\_\_
73. \_\_\_\_\_

OUTLINE OF INSTRUCTION

- (5) DO NOT allow prolong soaking in solvent to prevent possible damage to the printed circuit or components

2. Handtool removal

- a. Handtool removal consists of the removal of coating using controlled heat, scraping, and peeling
- b. Coating removal by controlled heat is effective on epoxies and polyurethanes

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

227

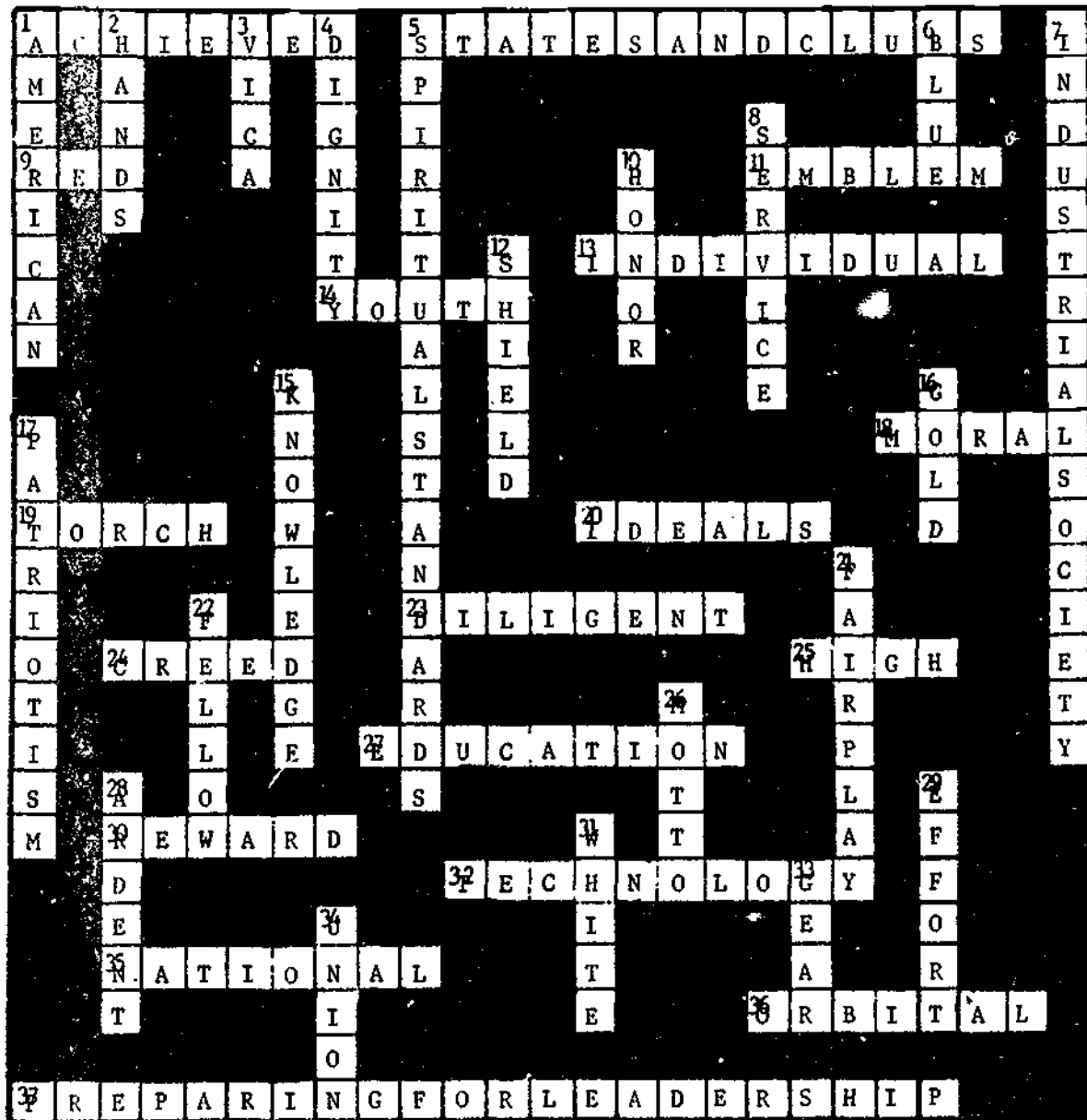
415

414

2-2-26

ANSWER KEY - ACTIVITY B

CROSSWORD PUZZLE



### OUTLINE OF INSTRUCTION

- c. Scraping and peeling removal is effective on some polyurethanes and some RIV compounds

### 3. Power tool removal

- a. Power tool removal consists of the removal of coatings using abrasive grinding and abrasive cutting methods
- b. Coating removal by abrasive cutting methods is effective on all coating applied in a thick layer (greater than 0.025 inch)

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

PRETEST - POSTTEST ANSWER KEY

- |          |           |           |
|----------|-----------|-----------|
| 1. False | 7. True   | 13. True  |
| 2. True  | 8. True   | 14. True  |
| 3. False | 9. True   | 15. True  |
| 4. True  | 10. False | 16. True  |
| 5. True  | 11. True  | 17. False |
| 6. False | 12. False |           |

Note: Answers 18-19 may be given in any order.

- 18. An opportunity to earn recognition for achievement.
- 19. Encourage excellence in skill training and leadership abilities.

Note: Answers 20-23 may be given in any order.

- 20. Secondary
- 21. Post-Secondary
- 22. Collegiate
- 23. Alumni

Note: Answers 24-29 may be given in any order.

- 24. I Believe In The Dignity Of Work

I shall maintain a feeling of humbleness for the knowledge and skills that I receive from craftsmen, and I shall conduct myself with dignity in the work I do.

- 25. I Believe In The American Way Of Life

I know our culture of today is the result of the freedom of action and opportunities won by our American forefathers, and I will uphold their ideals.

- 26. I Believe in Education

I shall endeavor to make the best use of the knowledge, skill, and experience that I learn in school in order that I may become a better workman in my chosen occupation and a better citizen in my community.

- 27. I Believe in Fair Play

I shall always conduct myself in the manner of the best craftsmen in my occupation, and treat those with whom I work as I would like to be treated.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

229

- c. Abrasive grinding removal techniques are effective on thinly applied coatings

D. Tools used in removal of conformal coatings

I. Handtools

- a. The following handtools are those normally used in the removal of conformal coatings

419



Pretest - Posttest Answer Key (Continued)

- |                              |                  |
|------------------------------|------------------|
| 55. International Industrial | 59. Specialist   |
| 56. American                 | 60. Operator     |
| 57. Leader                   | 61. Patriot      |
| 58. Expert                   | 62. Committeeman |
|                              | 63. Citizen      |

Note: Any of the following answers are acceptable for answers 64-68.

- |                         |                                |
|-------------------------|--------------------------------|
| Bulletin Board          | Occupational Scrapbook         |
| Club Business Procedure | Opening and Closing Ceremonies |
| Club Essay              | Outstanding Club               |
| Club Scrapbook          | Poster                         |
| Current Events          | Prepared Speech                |
| Display                 | Safety                         |
| Extemporaneous Speaking | Spelling                       |
| Job Interview           | Student of the Year            |
| Occupational Display    | Talent                         |

Note: Any of the following answers are acceptable for answers 69-73.

- Air Conditioning and Refrigeration
- Air Cooled Gasoline Engine Repair
- Appliance Repair
- Architectural Drafting
- Auto Body
- Auto Mechanics
- Bricklaying
- Building Trades
- Cabinet Making and Millwork
- Carpentry
- Commercial Art
- Commercial Food Trades
- Cosmetology
- Dental Assistant
- Dental Technician
- Electrical Trades
- Graphic Communications
- Heavy Duty Equipment Mechanic
- Industrial Electronics
- Machine Drafting
- Machine Shop
- Medical Assistant
- Medical Laboratory
- Mine Maintenance
- Nurse Assistant and Orderly
- Plumbing and Pipefitting
- Practical Nurse
- Radio and TV Repair
- Sheet Metal
- Welding

OUTLINE OF INSTRUCTION

(1) Small bristle brush

(2) Cotton swabs (Q-tips)

(3) X-acto knife

(4) Dental chisels

(5) Tweezers

(6) Varlap

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

420

2-2-29

421

230

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(7) Soldering iron

- b. The bristle brush and cotton swabs are handtools used in conjunction with chemical coating removal methods

2. Power tools

- a. The following power tools are those normally used in the removal of conformal coatings

(1) Miniature rotary tool kit (electric)

231

422

OUTLINE OF INSTRUCTION

(2) Abrasive cutting bit  
set for rotary tool

(3) Abrasive grinding bit  
set for rotary tool

(4) Variac

(5) Drill press

3. Proper selection and use of tools

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

332

OUTLINE OF INSTRUCTION

- a. The selection of tools and techniques to be used in removing a particular coating will be determined by the coating type and its thickness
- b. IN ALL CASES, the methods and tools chosen SHALL be those which are least likely to cause damage or degradation of any nature. Consideration must be given to the following factors in avoiding degradation
- (1) The effects of removal technique on board material

426

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

233

01 4.7

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
(2) The effects of removal technique on circuit board conductors		
(3) The effects of removal technique on adjacent components		
c. An evaluation of various conformal coating removal situations many tool/techniques combinations have applications in which they have proven to be reliable and effective. NO ONE METHOD best in all situations. The repair technician must make the determination of method to be used by keeping in mind at all times the REQUIREMENT OF causing NO damage or degradation to the assembly being repaired		

### OUTLINE OF INSTRUCTION

d. Heavily epoxied printed circuit board, which is a typical repair problem.

e. A coating which can be readily peeled may be removed using the following technique

### INSTRUCTOR ACTIVITY

d. . Display slide YXH L4-S11 and explain that it is also an example of selecting and using the ONE TOOL which must be used first on EVERY repair task. The tool referred to is the students brain which must be used to analyze thoroughly and completely each task before proceeding

### STUDENT ACTIVITY

235

431

431

OUTLINE OF INSTRUCTION

- (1) Use an X-Acto knife or dental chisel to CAREFULLY score and loosen the outer edges of the area to removed

- (2) Section to be removed is then carefully peeled away with tweezers

- f. An exaggerated example of coating removal by scraping is an extreme likelihood of damage when using the scraping method

INSTRUCTOR ACTIVITY

- f. Display slide YXH

STUDENT ACTIVITY



### OUTLINE OF INSTRUCTION

- h. Coating is removed by scraping, and how easy it is to cause damage due to the extreme thinness of the printed circuit conductors and plating
- (1) Scraping method should only be used as a last resort and only on thick coatings
- (2) NEVER attempt to remove all of the coating with this method. Leave a thin layer and finish removal with a less dangerous technique

434

### INSTRUCTOR ACTIVITY

- h. Display slide YXH L4-S13.

### STUDENT ACTIVITY

237

435

### OUTLINE OF INSTRUCTION

- (3) In scraping removal the tool used should have one flat side and one beveled or rounded side. The beveled side should be kept towards the board so it will have a tendency to cut up away from the board if you slip

1. Controlled heat is the most effective method of removing coatings with handtools

- (1) Coating being removed with an uncontrolled soldering iron. An uncontrolled heat source should NEVER be used for coating removal

### INSTRUCTOR ACTIVITY

- (1) Display slide YXH L4-S14 and stress this.

### STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

(2) Damage caused as a result of using uncontrolled heat. Board laminate and coating are both being charred

j. To correctly remove coating with the use of heat, a controlled power source such as a Variac must be used in conjunction with a soldering iron

(1) The optimum starting temperature may be obtained by adjusting the power source until the soldering iron will just barely melt solder

### INSTRUCTOR ACTIVITY

(2) Display slide XYH L4-S15 and describe damage caused.

### STUDENT ACTIVITY

239

439

428

2-2-38

OUTLINE OF INSTRUCTION

- (2) Next, CAREFULLY test the iron tip on the Particular coating being removed, and if necessary, adjust the temperature slightly upward or downward for most effective removal with NO damage to the workpiece.
- (3) The correct temperature range for removal of nearly all coatings is from 300 to 400 degrees F
- (4) The soldering iron tip should be shaped flat on one side and beveled on the other for safest and most effective removal

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

4.1.1

2-2-39

4.1.1

240

OUTLINE OF INSTRUCTION

(5) DO NOT attempt to remove all of the coating with this method. Leave a thin layer of coating, working carefully around component bodies and leads

k. Damage caused by using uncontrolled heat to remove coating is plainly discernible, while the careful application of controlled heat has not caused any damage

l. Thick conformal coatings may be cut away using the rotary tool kit in conjunction with the Variac and the abrasive cutting bit set

412

INSTRUCTOR ACTIVITY

(5) Display slide YXH L4-S16

2-2-40

STUDENT ACTIVITY

241

413

### OUTLINE OF INSTRUCTION

- (1) A medium-sized ball mill being used to reduce thickness of a heavy conformal coating
- (2) As the coating gets thinner or for close areas, a smaller cutting bit should be used
- (3) Once again, DO NOT attempt to remove all of the coating with this method

### INSTRUCTOR ACTIVITY

- (1) Display slide YXH L-4-S17
- (2) Display slide YXH L4-18

### STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

m. Extremely thick coatings such as a solid potted block may be removed using the drill press and the abrasive cutting bit set

(1) No Variac is needed with this method since the drill press has a built-in speed control

(2) EXTREME care must be taken when using this method since a very high probability of damage to the work-piece exists

(3) This method of removal is performed in the following manner

4.16

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

243

4.17

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>(a) Support the board on the bed of the drill press so that the board laminate is perfectly level with the bed</p> <p>(b) Using the mechanical lock, adjust the cutting bit to a fixed, immovable position equal to the desired depth of cut</p> <p>(c) Keeping the board level, remove the coating by lateral movement of the board beneath the rotating cutter bit (milling machine effect)</p>		



OUTLINE OF INSTRUCTION

(d) This method, like previous methods, is not suitable for removal of all the coating

n. Thinly applied coatings and coatings which have been reduced to a thin layer using other methods should be removed with the rotary tool kit and abrasive grinding bit set used in conjunction with the Variac

(1) Hard coatings and large areas of coatings should be removed with a relatively hard grinding bit such as a grit-impregnated rubber bullet wheel

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

245

451

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- (2) Soft or extremely thin coatings should be removed with the rotary bristle brush

- (3) The rotary bristle brush also works well in removing coatings from hard-to-get-at areas such as around components bodies and leads

- (4) This method is most effective when it is necessary to remove all of the coating down to the board surface

0509-10P1

452

2-2-48

453

246

OUTLINE OF INSTRUCTION

(5) Removing all of the conformal coating by the abrasive grinding method

(6) Use extreme caution whenever removing an entire layer of conformal coating. Avoid damage by always using the workpiece indicators (WPIs) to gauge the progress of your work

(a) WPIs are the indications which may be apparant to your five senses (sight, sound, touch, smell, and taste) of what is happening to the workpiece

INSTRUCTOR ACTIVITY

(5) Display slide YXH  
L4-S19

STUDENT ACTIVITY

247

455

OUTLINE OF INSTRUCTION

- (b) The copper shows through on the solder joint. They are the changing appearance of the solder-plated run and the changing color of the coating as you penetrate the final layer

E. Evaluating individual workpieces to determine proper techniques for removal of conformal coating

1. A careful, thorough physical examination must be made to determine the type of conformal coating

INSTRUCTOR ACTIVITY

1. Display slide YXH L4-S20

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

2. An analysis must be made to determine the most effective removal technique without damaging the workpiece

F. Inspecting completed work for damage to circuit board or remaining components

1. Board damage

- a. Scorching or charring caused by component failure or improper repair techniques

INSTRUCTOR ACTIVITY

1. Display slide YXH L4-S21

STUDENT ACTIVITY

249

450

OUTLINE OF INSTRUCTION

b. Measling, which is the appearance of white spots that are all areas of the fiber glass strands which have been exposed by heat, abrasive, or solvent action

c. Possible cracks or breaks in the board material

2. Conductor damage

a. Any missing pads or conductors

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

460

461

250

OUTLINE OF INSTRUCTION

b. Any nicked or cracked conductors

c. Lifted or delaminated pads or conductors--

3. Component damage

a. Cracked, broken or over-heated components

b. Deformed or broken components leads

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

251

462

463

OUTLINE OF INSTRUCTION

G. Safety precautions

1. Workpiece

a. Same as previous lessons

2. Tool

a. Same as previous lessons

INSTRUCTOR ACTIVITY

G. Display slide YXH  
L4-S22, review of  
safety precautions

STUDENT ACTIVITY

495

252



253

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

3. Personal

a. Same as previous lessons

H. Demonstration

1. Conformal coating removal

1. Instructor should demonstrate the proper techniques and use of tools while showing the students how to remove conformal coatings from circuit boards using the chemical, heat and abrasive methods, as covered during the lesson.

1. Observe and ask questions if necessary.

406

407

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>III. <u>APPLICATION</u></p> <p>Performance Sheet 2-2-1P</p>	<p>Supervise each student's completion of performance sheet, emphasizing safety.</p>	<p>Complete performance sheets. Ask questions if procedures are not clear.</p>
<p>IV. <u>SUMMARY</u></p> <p>A. Introduction</p>	<p>A. Emphasize importance of the summary for the student.</p>	
<p>1. Nature of summary</p>		
<p>2. Purpose of summary</p>		

0504P1

400

2-2-53

400

254

OUTLINE OF INSTRUCTION

B. Directions to students

1. Questions

2. Notes

C. Recap of lesson - completed during demonstration

471

INSTRUCTOR ACTIVITY

C. Emphasize safety

2-2-54

STUDENT ACTIVITY

255

C. Ask questions if material not clear; check notes to insure accuracy and completeness

471

0504P1

OUTLINE OF INSTRUCTION

V. INFORMAL TEST

There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application."

VI. ASSIGNMENT

Read and study 2-2-1N and 2-2-1N.

INSTRUCTOR ACTIVITY

Provide students with the homework assignment.

STUDENT ACTIVITY

Ask questions if the assignment is unclear.  
Complete assignment.

0504P1.

472

2-2-55

473

256

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

Lesson Topic 2.3:  
Desoldering Printed Circuit Board Components

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 2.0 Hours  
Laboratory - 3.25 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

a. MERP/2M Kit

2. Training Aids

a. Slides

(1) YXH L5-S1 through YXH L5-S52

3. Training Aids Equipment

a. Projector, Slide

b. Screen, Projection, Standard

4. Text

a. Student's Guide

5. References

a. Volume 6, PACE Rework and Repair Technology Series

TERMINAL OBJECTIVES

Supported entirely by this lesson topic:

3.0 REMOVE printed circuit component parts using the correct tools and desoldering techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.

ENABLING OBJECTIVES

When you complete this lesson topic, you will be able to:

2.3.1 IDENTIFY the various types of printed circuit solder connections by visual inspection of selected printed circuit boards. Identification will be in agreement with the connection listed in Volume 6 of the PACE Rework and Repair Technology Series.

2.3.2 EVALUATE the repair task to be performed and DETERMINE the proper desoldering and component removal method to be used on selected printed circuit boards utilizing information contained in Volume 6 of the PACE Series.

1982-82P8

- 2.3.3 DESOLDER various types of printed circuit solder connections using the wicking, manual vacuum and motorized vacuum extraction methods and proper tools necessary as outlined in Volume 6 of the PACE Series.

#### CRITERION TEST

Given selected printed circuit boards the student will be required to identify various solder connections, evaluate the repair tasks to be performed and correctly desolder a minimum of four components for each of the extractions methods, with minimum degradation to the circuit boards.

#### HOMEWORK

OUTLINE OF INSTRUCTION

I. INTRODUCTION

A. Contact

B. Readiness

INSTRUCTOR ACTIVITY

A. Introduce self and topic.  
Provide for students needs:

1. Muster

2. Comfort

3. Visibility and seating

B. Explain value of subject  
matter, pointing out where  
appropriate, its relationship  
to the following:

STUDENT ACTIVITY

473

2-3-3

1984-85P8

477

## TABLE OF CONTENTS

	Page
Introduction . . . . .	iii
Notes to Student . . . . .	iv
Objectives . . . . .	iv
Pretest . . . . .	1
Learning Activity A: Vocabulary . . . . .	5
Learning Activity B: Personal Data Sheet . . . . .	10
Learning Activity C: Letter of Application . . . . .	23
Learning Activity D: Application Form . . . . .	30
Learning Activity E: Job Interview . . . . .	38
Posttest . . . . .	45
Answer Key for Learning Activities . . . . .	49
Pretest and Posttest Answer Key . . . . .	53



OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

260

1. Accomplishment of daily tasks aboard ship.
2. The necessity of the skills and techniques in repair of printed circuit boards.
3. Personal applications of the knowledge and skills.
4. Seek to motivate. Tell a good tie-in story if possible.

460

479

2-3-4

1984-85P8

## NOTES TO STUDENTS

The material in this (LAP) is designed to assist persons who are seeking gainful employment. It is most likely that you have already applied for and received a Social Security number, and are of legal age according to the definitions of the United States Department of Labor and the Virginia Department of Labor, to be employed. If you do not have a Social Security card, ask your teacher to help you to obtain one. You should have already identified areas of your interest and/or aptitudes, which will help you in the job hunting process.

Answers to the tests and review exercises are located at the end of the LAP. Check the Table of Contents for the page numbers.

## OBJECTIVES

When you have completed this LAP, you will be able to demonstrate your knowledge of job application and interview by completing these objectives with 90 percent accuracy.

- A. (a) Write the meaning of ten terms related to job application and interview, (b) identify seven items that should be part of the personal data sheet and (c) answer correctly fifteen general items on job application and interview.
- B. Prepare a personal data sheet which (a) includes the five basic categories of information, and (b) is neat and free from errors.
- C. Write a letter of application which (a) follows the six part format and (b) is grammatically correct.
- D. Complete a job application form (a) using correct responses to all items and (b) that is grammatically correct.
- E. Identify conditions to be aware of during the job interview:  
(a) ten questions which would typically be asked and  
(b) ten positive conditions or responses which would help you get the job.

OUTLINE OF INSTRUCTION

C. Effect

INSTRUCTOR ACTIVITY

C. When following a subject matter lesson topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).
2. Commend students for mastery of skills in previous lesson(s).

D. Overview lesson by:

STUDENT ACTIVITY

Pretest (Continued)

Circle T if statement is True, F if it is False

- T F 25. You should include your phone number in the application letter.
- T F 26. The inside address block is also your return address.
- T F 27. The date block is located in the upper right-hand corner of the letter.
- T F 28. The body of the letter should be one continuous paragraph.
- T F 29. The salutation is the closing of the letter.
- T F 30. The signature should be typewritten.
- T F 31. Your letter should include grade point average and some important courses which you took.
- T F 32. Paragraph one should explain the purpose of the letter to the employer.
- T F 33. Your letter should include several references.
- T F 34. You should appear at the interviewer's office precisely on time.
- T F 35. You should bring your high school transcript along to the interview.
- T F 36. It is considered good practice to ask the interviewer the exact pronunciation of his/her name.
- T F 37. It is good to extend thanks to both the interviewer and receptionist.
- T F 38. After greeting the receptionist you should state your business and time of appointment.
- T F 39. Your own questions should be asked at the beginning of the interview.

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

262

1. Stating learning objectives as contained on cover pages to this topic.

2. Stating procedures to be followed during the lesson.

a. Taking notes

b. Asking questions

c. Use of criterion test

484

483

2-3-6

## LEARNING ACTIVITY A

### VOCABULARY

Objective: You will be able to write the meaning of ten terms related to job application and interview, identify seven items that should be part of the personal data sheet, and answer correctly fifteen general items on job application and interview.

Introduction: On the following page is a list of words which you should know in order to understand terms which may be used on job application forms, in a letter of application, on your personal data sheet, and during the job interview. Look them up in a dictionary and familiarize yourself with these words and their meanings. In the space provided, write the dictionary definition. If there are several meanings, select the one which refers to job application and employment. As you complete the LAP, refer back to these words anytime you feel it is necessary. To help you remember the meanings of the definitions of the vocabulary words, fill in the crossword puzzle and anagram which follow.



## Vocabulary (Continued)

Write the meaning of the following terms as they relate to job applications.

1. Applicant \_\_\_\_\_  
\_\_\_\_\_
2. Application \_\_\_\_\_  
\_\_\_\_\_
3. Apply \_\_\_\_\_  
\_\_\_\_\_
4. Complete \_\_\_\_\_  
\_\_\_\_\_
5. Concise \_\_\_\_\_  
\_\_\_\_\_
6. Denied \_\_\_\_\_  
\_\_\_\_\_
7. Dependent \_\_\_\_\_  
\_\_\_\_\_
8. Experience \_\_\_\_\_  
\_\_\_\_\_
9. Fired \_\_\_\_\_  
\_\_\_\_\_
10. Former \_\_\_\_\_  
\_\_\_\_\_
11. Hired \_\_\_\_\_  
\_\_\_\_\_
12. Hobbies \_\_\_\_\_  
\_\_\_\_\_

13

## OUTLINE OF INSTRUCTION

### II. PRESENTATION

- A. Recognition and characteristics of printed circuit solder-joint types

1. Common joint types

- a. To recognize the various solder-joint types you must take into consideration board circuitry style, lead termination style, and the style of hole reinforcement.

## INSTRUCTOR ACTIVITY

3. Invite questions concerning objectives and procedures

- A. Using the appropriate slides explain the characteristics of the various PC solder-joint types

## STUDENT ACTIVITY

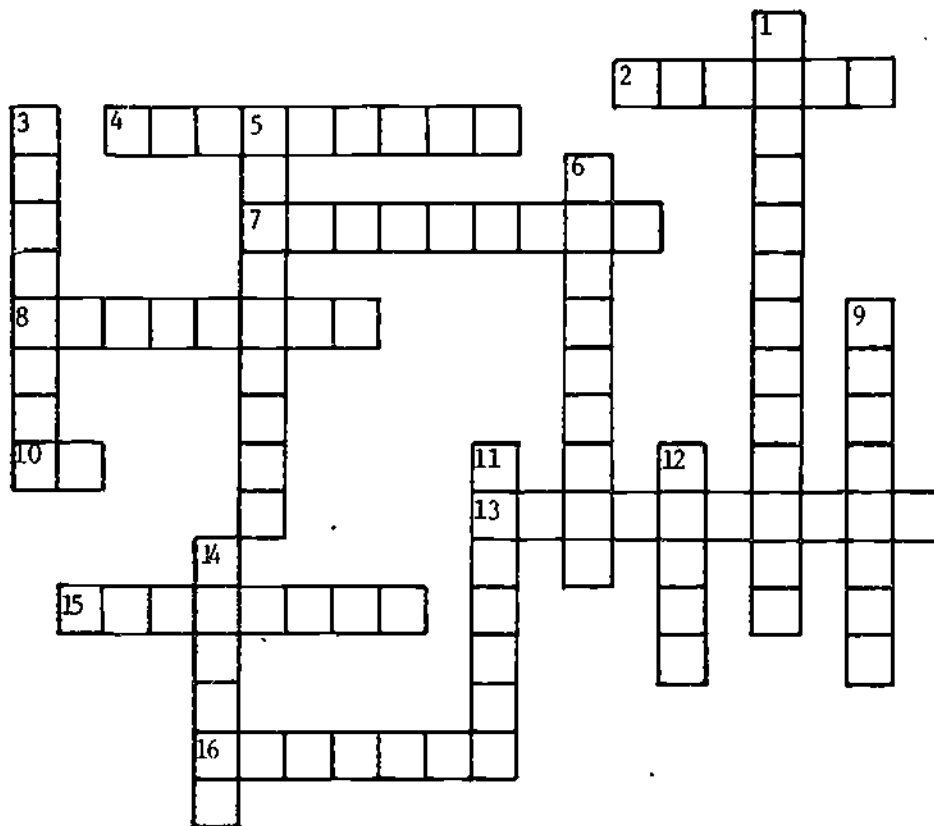
3. Ask questions concerning objectives or procedures if in doubt



Vocabulary (Continued)

CROSSWORD PUZZLE

Complete the crossword puzzle using sixteen of the twenty-six terms listed on the previous pages. Clues to the puzzle are provided below.



ACROSS

2. payment for work
4. members of your family
7. employees of a company
8. a safe, steady job
10. does not apply
13. a particular field of work
15. to fill out fully
16. your last name

DOWN

1. tells if you are single, married, divorced, separated or widowed
3. to have left out
5. one who applied for a job
9. a person who will speak well of you
11. clear, brief and to the point
12. make application for a job
14. your husband or wife

OUTLINE OF INSTRUCTION

b. Of the three considerations, board circuitry style is the easiest to recognize.

(1) A single-sided board which has conductors on one side only

(2) A double-sided board which has conductors on both sides

c. The consideration of hole support is generally the hardest to identify because it is often hidden beneath the solder.

487

INSTRUCTOR ACTIVITY

(1) Display Slide YXH L5-S2, "Comparison of Single- and Double-Sided Circuitry"

STUDENT ACTIVITY

264  
490

488

2-3-8

## LEARNING ACTIVITY B

### PERSONAL DATA SHEET

Objective: You will be able to prepare a personal data sheet which (a) includes the five basic categories of information and (b) is neat and free from errors.

Introduction: The personal data sheet contains important information about you. The information found in a personal data sheet is similar to that which you will be asked during a job interview. The personal data sheet should be typed or printed in ink as neatly as possible. Take your personal data sheet with you when applying for a job. The information can be copied from it onto the application form. By following this procedure, you will be able to do a better, more accurate job of filling out your application. This will help give the interviewer a more favorable first impression of you. Make several copies of the personal data sheet to leave with the interviewer and/or send with letters of application.

The personal data sheet is normally divided into five parts. The five parts are: personal information, educational information, skill information, work experience, and personal references. On the following page there is a brief explanation of each part along with an example of each. Following the examples which are given, make your own personal data sheet. Use a telephone book to look up phone numbers and addresses of which you are not sure. Remember to use a dictionary to help you spell words correctly. Be as neat and accurate as possible, and do not make any mistakes on the personal data sheet.

OUTLINE OF INSTRUCTION

(1) Various hole support methods  
you may encounter

(2) The methods from left to  
right are

(a) No hole reinforcement  
in single-sided board

(b) Plated-through hole  
in single-sided board

(c) Roll-set eyelet in  
single-sided board,

INSTRUCTOR ACTIVITY

(1) Display Slide YXH L5-S3,  
"Hole Support Methods"

STUDENT ACTIVITY

Personal Data Sheet (Continued)

EDUCATIONAL INFORMATION

List only the high school from which you will graduate. Any college or technical school you are attending or have attended should also be included. Be sure you give the full name, address, and zip code for the schools. Because you have not yet graduated from high school, state the month and year that you anticipate graduation. Below the high school listing, make a list of the subjects studied. Begin your list with subjects which are technical in nature or that could possibly clarify your qualifications for a particular job. List your required subjects last.

SAMPLE

Education

Will graduate from Manchester High School, 7401 Hull Street Road,  
Richmond, Virginia 23235 in June 19\_\_

Subjects studied:

Industrial Cooperative Training, 2 years  
Industrial Arts, 1 year  
Home Economics, 1 year  
English, 4 years  
History, 3 years  
Math, 1 year  
Science, 1 year

Note: The specialized courses are listed first and the required courses are given last.

15

OUTLINE OF INSTRUCTION

- (d) Plated-through hole  
in double-sided board
- (e) Funnel-set eyelet in  
double-sided board
- (f) Fused flat-set eyelet  
in double-sided board
- (3) Single-sided board which has  
no hole support
- (4) Single-sided board which has  
plated-through holes

INSTRUCTOR ACTIVITY

- (3) Display Slide YXH L5-S4,  
"Single-Sided Board  
With no Hole Support"
- (4) Display Slide YXH L5-S5,  
"Single-Sided Board  
With Plated-Through  
Holes"

STUDENT ACTIVITY

998

491

492

Personal Data Sheet (Continued)

SKILLS INFORMATION

Skills are special qualifications or abilities. They include talents, and any special training or education you may have. Think of them as things which you can do that someone else cannot do, regardless of how simple they may be. In the future you may omit some of the more simple skills. You will want to list skills which are more technical in nature.

SAMPLE

Skills

Industrial Cooperative Training Experience includes:

Commerical and Industrial Wiring (300 hours)

Residential Wiring (165 hours)

A.C. Motors and Alternators (150 hours)

D.C. Motors and Generators (37 hours)

Transformers and Rectifiers (37 hours)

Skills

---

---

---

---

---

---

---

---

21

OUTLINE OF INSTRUCTION

- (5) Module which has roll-set eyelets in a single-sided board
- (6) Double-sided board which has plated-through holes
- (7) Double-sided board which has funnel-set eyelets
- (8) Double-sided board with flat-set eyelets which are fused to the circuit conductors by heat and pressure

INSTRUCTOR ACTIVITY

- (5) Display Slide YXH L5-S6, "Single-Sided Board With Roll-Set Eyelets"
- (6) Display Slide YXH L5-S7, "Plated-Through Hole in Double-Sided Board"
- (7) Display Slide YXH L5-S8, "Double-Sided Board With Funnel-Set Eyelets"
- (8) Display Slide YXH L5-S9, "Double-Sided Board With Fused Flat-Set Eyelets"

STUDENT ACTIVITY



Personal Data Sheet (Continued)

In the space below, fill in information about yourself:

Work Experience:

Dates		Name & Address of Employer	Description of Duties	Wages	
From	To			Starting	Final
<hr/>					
<hr/>					
<hr/>					
<hr/>					
<hr/>					

### OUTLINE OF INSTRUCTION

d. Hole supports normally form interfacial connections which are a means of electrically joining the circuitry on double-sided boards

(1) Various hole supports used as interfacial connections

(2) From left to right on the top row, they are a clinched busswire soldered on both sides, a funnelet and a funnel-set eyelet

(3) From left to right on the center row, they are a roll-set eyelet, a plated-through hole filled with solder, and a flat-set eyelet

### INSTRUCTOR ACTIVITY

(1) Display Slide YXH L5-S10, "Interfacial Connections"

### STUDENT ACTIVITY

268

496

495

1986-87P8

2-3-12

Personal Data Sheet (Continued)

Make a list of your references in the space below:

References:

---

---

---

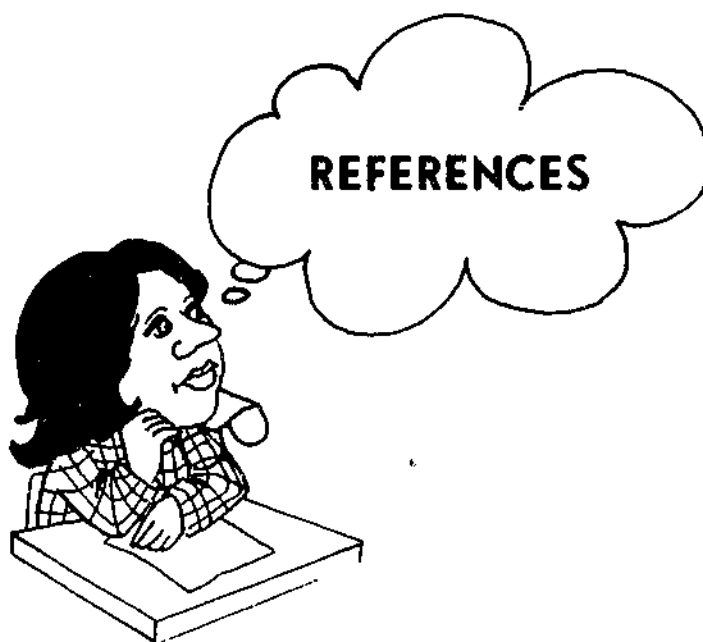
---

---

---

---

---



24

### OUTLINE OF INSTRUCTION

- (4) From left to right on the bottom row, they are a flat-set fused eyelet and a petal-set fused eyelet

- (5) Star- or petal-set eyelets in use

- e. The consideration of lead termination style is the final factor in determining printed circuit solder-joint lead terminations

- (1) A fully clinched lead, a common type often used in machine soldering as well as hand soldering

### INSTRUCTOR ACTIVITY

- (5) Display Slide YXH L5-S11, "Star- or Petal-Set Eyelets"

- (1) Display Slide YXH L5-S12, "Component Lead Terminations"

### STUDENT ACTIVITY

Personal Data Sheet (Continued)

Skills

Industrial Cooperative Training Experience includes:

Commercial And Industrial Wiring (300 hours)  
Residential Wiring (165 hours)  
A.C. Motors and Alternators (150) hours)  
D.C. Motors and Generators (37 hours)  
Transformers and Rectifiers (37 hours)

Work Experience:

Dates From	To	Name & Address of Employer	Description of Duties	Wages	
				Starting	Final
Sept. 19__	Present	Odom Electric Shop 2343 Hull St. Road Richmond, Virginia 23234	Electrician Trainee	\$4.30 per hr.	\$4.50 per hr.
Oct. 19__	Sept. 19__	Willard Electric Co. 9340 Cambridge Road Chester, Virginia 23831	Electrician Trainee	\$3.65 per hr.	\$4.00 per hr.

References:

- Mr. Louis Johnston, 3112 Lee Highway, Bon Air, Virginia 23235  
Sales Manager, Exxon Corporation, 804-455-1234
- Ms. Jane Robek, Trade and Industrial Education Service  
Secretary, Virginia Department of Education  
Box 6Q, Richmond, Virginia 23216, 804-786-2154
- Mr. Michael Rogers, 821, Little River Turnpike, Richmond, Virginia 23225  
Counselor, Meadowbrook High School, 4901 Coghill Road,  
Richmond, Virginia, 804-786-2646

OUTLINE OF INSTRUCTION

- (2) A-semiclinched lead, easier to remove than a full clinch during repair
- (3) A straight-through termination which provides the greatest degree of repairability
- (4) Offset pad termination which has hole drilled outside of pad area
- (5) A crimped lead on the component side which provides component clearance for improved solvent cleaning and air circulation. This also provides clearance to prevent components with a high operating temperature from scorching the circuit board. Note that this is NOT a lead termination but a component mounting method

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

270

509

499

Personal Data Sheet (Continued)

Skills:

---

---

---

---

---

---

---

---

Work Experience:

Dates		Name & Address of Employer	Description of Duties	Wages	
From	To			Starting	Final

---

---

---

---

---

References:

---

---

---

---

---

---

---

### OUTLINE OF INSTRUCTION

- (6) A spaded lead termination in which the end of the lead is mashed or crimped after being passed through the printed circuit board. NOTE THAT THIS STYLE OF TERMINATION IS EASILY HIDDEN BY THE SOLDER AND THAT THE LEAD MUST BE CUT BETWEEN THE COMPONENT AND THE SPADED PORTION BEFORE ATTEMPTING TO REMOVE THE LEAD FROM THE HOLE

- (7) Offset pad mounting

- (8) Improved designs of offset pads which provides greater lead length to protect the component from the heat of the soldering operation.

### INSTRUCTOR ACTIVITY

- (7) Display Slide YXH L5-S13, "Module Using Offset Pads". NOTE that component removal is relatively easy.

- (8) Display Slide YXH L5-S14, "Improved Version of Offset Pads" NOTE that this type of termination MUST be hand soldered

### STUDENT ACTIVITY



## Letter of Application (Continued)

### LETTER OF APPLICATION

The letter of application can be divided into six parts. The following examples will aid you in placing the necessary information in the correct sequence. Let's look at the various parts.

1. Date block or heading:

This is located in the upper right-hand side of the page, approximately two inches from the top. It includes only the address and date.

2. The inside address:

This is located at the left margin of the letter, four spaces below the heading and includes the name and address of the person to whom you are sending the letter.

3. Salutation:

The salutation is located on the left margin two spaces below the inside address. It should consist of "Dear Sir", "Dear Madam", "Dear Ms. \_\_\_\_\_", or "Dear Mr. \_\_\_\_\_", followed by the last name of the person to whom you are writing.

4. The body of the letter:

The body contains the information. It may be divided into five paragraphs.

Paragraph 1: This paragraph tells the employer why you have written the letter and that you would like to be considered for the job.

Paragraphs 2 & 3: These paragraphs tell the employer about education, training, and work experience which may qualify you for the job.

Paragraph 4: This paragraph reveals to the employer your career plans and your plans for continuing education.

Paragraph 5: This paragraph is the closing of the letter. It lets the employer know that you would like an interview and how you may be reached.

33

### OUTLINE OF INSTRUCTION

- (9) Lap solder-joining lead termination in which the component lead does NOT pass through the circuit board.

#### 2. Identification methods

- a. **WARNING:** When identifying solder-joint types, apt to find several different styles of solder-joint construction on a single printed circuit board
- b. Apt to encounter component leads **WELDED** to the printed circuit conductors

### INSTRUCTOR ACTIVITY

- (9) Display Slide-YXH L5-S15, "Lap Joint Terminations"  
NOTE that a lap joint may be used with both round and flat leads

- a. Stress this fact.

### STUDENT ACTIVITY

272

504

503

Letter of Application (Continued)

SAMPLE

7900 Messer Road  
Richmond, Virginia 23231  
April 8, 19\_\_

1 DATE BLOCK  
or HEADING

Mr. Richard Owens  
Personnel Director  
Henrico Electric, Inc.  
1352 Parham Road  
Richmond, Virginia 23234

2 INSIDE ADDRESS

Dear Mr. Owens:

3 SALUTATION

4 BODY

Mr. Robert Clark, Industrial Cooperative Training Coordinator at Varina High School, suggested that I write you in regard to the electrician apprenticeship position in your firm. Please consider me as an applicant for this position.

During the past two years I have been enrolled in an Industrial Cooperative Training at Varina High School. This is a supervised occupational program offering fifteen hours of on-the-job training per week.

The program has given me an opportunity to receive training in your particular type of work. I have enclosed a copy of my Individual Training Plan and Record which documents my on-the-job experiences in the program.

Upon graduation in June, I plan to continue my education in the evening. My goal upon completion of my education is to become an expert electrician.

Should you be interested in arranging an interview, please contact me in the evening at 222-0925. Thank you for your consideration.

Sincerely yours,

5 COMPLIMENTARY  
CLOSING

6 SIGNATURE

*Louise Booker*  
Louise Booker

Enclosure

32

### OUTLINE OF INSTRUCTION

- c. Welded leads MUST NOT be mistaken for solder joints since they CANNOT be removed with a soldering iron.

- (1) The fine black line across the component lead is the identifying characteristic of a welded joint.
- (2) Any attempt to remove the lead with a soldering iron will damage the board by overheating without disturbing the weld

- d. Means to identify board circuitry style

### INSTRUCTOR ACTIVITY

- c. Display Slide YXH L5-S16, "Example of Welded and Soldered Leads on a Single Module". NOTE that there is a combination of welded and soldered leads in the same module.

### STUDENT ACTIVITY

Letter of Application (Continued)

LETTER OF APPLICATION REVIEW

Answer the following questions about the letter of application.

Check your answers with the key at the end of the LAP.

1. What is the purpose of a letter of application?
2. List the six major parts of the letter of application:
  - a. d.
  - b. e.
  - c. f.
3. List five points you should remember when writing a letter of application:
  - a.
  - b.
  - c.
  - d.
  - e.

Circle T if the statement is True, F if it is False.

- T F 1. A letter of application should be written in pencil.
- T F 2. Because you know what you are going to say, you do not need a rough draft.
- T F 3. In the closing, only the first word is capitalized.
- T F 4. The salutation is the person writing the letter.
- T F 5. The signature of a letter is always typed.
- T F 6. Never provide your phone number on a letter of application.
- T F 7. You should state the job for which you are applying.

OUTLINE OF INSTRUCTION

(1) Inspect visually

(2) Use a bright light to backlight the board if needed to show relationship of interconnection paths

e. Means to identify lead termination style

(1) Inspect visually

(2) Remove solder from joint to determine if there are hidden termination characteristics

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

374

508

507

1989-90P8

2-3-18

## LEARNING ACTIVITY D

### APPLICATION FORM

Objective: You will be able to complete a job application form (a) using correct responses to all items and (b) which is grammatically correct.

Introduction: The application form plays a very important role in assisting you to get the job you want. It is also the first judgment factor that the interviewer has of the applicant. The impression of the applicant made by the application form stays with the personnel official throughout the interview.

Follow the instructions in detail when filling out the application form. Make certain that your handwriting is neat and accurate. "Blow your own horn" by listing all your abilities, skills and aptitudes. If you do not sell yourself, no one else will. Be honest when listing your qualifications. Remember, the secret of gaining employment is not only education and training, but also the image you project to a prospective employer.



30

OUTLINE OF INSTRUCTION

f. Means to identify hole reinforcement styles

(1) Inspect visually

(2) Remove all solder from the connection, CAREFULLY, to determine hidden hole support characteristics

B. Desoldering methods for printed circuit solder joints

1. Removal by wicking

INSTRUCTOR ACTIVITY

B. Describe the different methods of desoldering and removing component parts from printed circuit boards

STUDENT ACTIVITY



## The Application Form (Continued)

### THE APPLICATION FORM

In this section you will find a completed job application form. Review it carefully and then fill out the blank application provided. Complete the form as carefully and neatly as you would if you were in the interviewer's office.

Upon completion of the application, evaluate your work using the job application checklist found on page 37. Keep in mind that the only recorded information concerning you which the interviewer has is the application form in the company file. How well you complete it may make the difference between getting or not getting the job.



### OUTLINE OF INSTRUCTION

- a. Solder removal by the wicking method consists of using finely stranded wire (either braided or twisted) in conjunction with liquid flux and heat to cause all but an extremely thin layer of solder to be removed from the joint
  - b. Capillary action causes the solder to be drawn up into the wicking material
  - c. This action is aided by the liquid flux ability to increase wetting action
- 
2. Manual vacuum extraction

511

### INSTRUCTOR ACTIVITY

- a. Display Slide YXH L5-S17, "The Wicking Method"

2. Display Slide YXH L5-S18, "Manual Vacuum Extractor"

2-3-20

### STUDENT ACTIVITY

276

512

APPLICANT'S EXPERIENCE - COMPLETELY ACCOUNT FOR ALL PERIODS OF THE SERVICE USE ADDITIONAL APPLICATIONS IF NECESSARY

Present Employer Name: <u>Oden Electric Shop</u>	Start Date Date: <u>4.50</u>	Weekly Hours: <input checked="" type="checkbox"/> <u>8</u>
Address: <u>2343 Hull Street Road Richmond VA 23234</u>	Start Date Date: <u>9-6-1981</u>	Leaving Date Date: <u>6-30-1982</u>
Occupation and Nature of Work: <u>Electrician Trainee</u>	Reason for Leaving: <u>Lay-off</u>	Name of Person for Whom You Worked: <u>MR Charles Hooper</u>
Previous Employer Name: <u>Willard Electric Company</u>	Start Date Date: <u>4.00</u>	Weekly Hours: <input checked="" type="checkbox"/> <u>8</u>
Address: <u>9340 Cambridge Road Chester VA 23031</u>	Start Date Date: <u>10-5-1980</u>	Leaving Date Date: <u>9-1-1981</u>
Occupation and Nature of Work: <u>Electrician Trainee</u>	Reason for Leaving: <u>Distance from home to work</u>	Name of Person for Whom You Worked: <u>MR. Dan Looney</u>
Previous Employer Name: <u>N/A</u>	Start Date Date: <u>N/A</u>	Weekly Hours: <input type="checkbox"/> <u>N/A</u>
Address: <u>N/A</u>	Start Date Date: <u>N/A</u>	Leaving Date Date: <u>N/A</u>
Occupation and Nature of Work: <u>N/A</u>	Reason for Leaving: <u>N/A</u>	Name of Person for Whom You Worked: <u>N/A</u>

SUMMARIZE ANY SIGNIFICANT EDUCATIONAL DETAILS, EXPERIENCE, TRAINING, OR QUALIFICATIONS THAT HAVE NOT BEEN COVERED. SHOW SPECIAL SKILLS, PATENTS HELD, PROFESSIONAL LICENSES AND CERTIFICATES, ETC

My Industrial Cooperative Training Program includes the following experiences:

Commercial and Industrial Wiring (300 hours);

Residential Wiring (165 hours); Transformers and Rectifiers (37 hours);

A.C. Motors and Alternators (150 hours);

D.C. Motors and Generators (37 hours).

The Rehabilitation Act of 1973 and the Readjustment Assistance Act of 1974 require that all applicants be afforded the opportunity to identify themselves as handicapped, a Vietnam era veteran or a disabled veteran.

Do you consider yourself to be

Handicapped? Yes No X

Handicapped? N/A

Disabled Veteran? Yes No X

Vietnam Era Veteran? Yes No X

PLEASE NOTE - APPLICANT AGREES TO THE FOLLOWING CONDITIONS OF EMPLOYMENT

1. EMPLOYMENT IS CONDITIONAL UNTIL RESULTS OF PRE-PLACEMENT HEALTH EVALUATION ARE KNOWN AND RELATED TO SPECIFIC JOB REQUIREMENTS AND UNTIL INFORMATION GIVEN BY APPLICANT HAS BEEN VERIFIED
2. MEETING MINIMUM AGE REQUIREMENTS OF APPLICABLE LAWS
3. SIGNING AN AGREEMENT RELATING TO ASSIGNMENT OF INVENTIONS IF REQUIRED
4. COMPLETING AND EXECUTING SURETY BOND APPLICATION IF REQUIRED
5. WILLINGNESS TO ACCEPT TRAVEL ASSIGNMENTS WHEN JOB DUTIES SO REQUIRE
6. WILLINGNESS TO WORK OVERTIME AND OTHER THAN STANDARD SHIFT HOURS WHEN JOB DUTIES SO REQUIRE
7. THAT INITIAL EMPLOYMENT IS CONDITIONAL ON OBTAINING ACCEPTABLE CLEARANCE FROM DEPARTMENT OF DEFENSE WHEN JOB DUTIES SO REQUIRE
8. THAT EMPLOYMENT OF AT LEAST 15 YEARS SERVICE IS REQUIRED AT THE END OF THE MONTH IN WHICH AGE 65 IS REACHED TO QUALIFY FOR A SERVICE PENSION FROM THE WESTERN ELECTRIC COMPANY
9. TO CONFORM TO OTHER COMPANY RULES, REGULATIONS AND INSTRUCTIONS

IT IS UNDERSTOOD THAT IF EMPLOYED, FALSE STATEMENTS ON THIS APPLICATION SHALL BE CONSIDERED SUFFICIENT CAUSE FOR DISMISSAL

Signature of Applicant: Minnie Lorina Burke Date: March 19, 1982

Employment Date: \_\_\_\_\_ Date: \_\_\_\_\_

Applicant's Comments:

### OUTLINE OF INSTRUCTION

- a. Solder removal using the manual vacuum method consists of a manually controlled and operated one-shot vacuum source in conjunction with heat to create a vacuum airflow which pulls molten solder from the joint
- b. Manual vacuum usually has the advantage of instant vacuum rise-time (zero to maximum vacuum with no time delay)
- c. Manual vacuum disadvantages
  - (1) Extremely high vacuum levels which may cause damage by lifting conductors from printed circuit boards since the conductor bonding material has greatly reduced strength at solder melting temperatures

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

**APPLICANT'S EXPERIENCE - COMPLETELY ACCOUNT FOR ALL PERIODS OF EMPLOYMENT. USE ADDITIONAL SHEET IF NECESSARY.**

Present Employer Name _____	Start Date Of Pay _____	Weekly Monthly <input type="checkbox"/> <input type="checkbox"/>	Hours <input type="checkbox"/>
Address _____	Start Date _____	Leaving Date _____	
Occupation and Nature of Work _____	Reason for Leaving _____	Name of Person for Whom You Worked _____	
Next Employer Name _____	Start Date Of Pay _____	Weekly Monthly <input type="checkbox"/> <input type="checkbox"/>	Hours <input type="checkbox"/>
Address _____	Start Date _____	Leaving Date _____	
Occupation and Nature of Work _____	Reason for Leaving _____	Name of Person for Whom You Worked _____	
Next Employer Name _____	Start Date Of Pay _____	Weekly Monthly <input type="checkbox"/> <input type="checkbox"/>	Hours <input type="checkbox"/>
Address _____	Start Date _____	Leaving Date _____	
Occupation and Nature of Work _____	Reason for Leaving _____	Name of Person for Whom You Worked _____	

SUMMARIZE ANY SIGNIFICANT EDUCATIONAL DETAILS, EXPERIENCE, TRAINING, OR QUALIFICATIONS THAT HAVE NOT BEEN COVERED. SHOW SPECIAL SKILLS, PATENTS HELD, PROFESSIONAL LICENSES AND CERTIFICATES, ETC

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

The Rehabilitation Act of 1973 and the Readjustment Assistance Act of 1974 require that all applicants be afforded the opportunity to identify themselves as handicapped, a Vietnam era veteran or a disabled veteran.

Do you consider yourself to be

Handicapped? Yes \_\_\_\_\_ No \_\_\_\_\_

Nature of Handicap \_\_\_\_\_

Disabled Veteran? Yes \_\_\_\_\_ No \_\_\_\_\_ Vietnam Era Veteran? Yes \_\_\_\_\_ No \_\_\_\_\_

**PLEASE NOTE - APPLICANT AGREES TO THE FOLLOWING CONDITIONS OF EMPLOYMENT.**

1. EMPLOYMENT IS CONDITIONAL UNTIL RESULTS OF PRE-PLACEMENT HEALTH EVALUATION ARE KNOWN AND RELATED TO SPECIFIC JOB REQUIREMENTS AND UNTIL INFORMATION GIVEN BY APPLICANT HAS BEEN VERIFIED
2. MEETING MINIMUM AGE REQUIREMENTS OF APPLICABLE LAWS
3. SIGNING AN AGREEMENT RELATING TO ASSIGNMENT OF INVENTIONS IF REQUIRED
4. COMPLETING AND EXECUTING SURETY BOND APPLICATION IF REQUIRED
5. WILLINGNESS TO ACCEPT TRAVEL ASSIGNMENTS WHEN JOB DUTIES SO REQUIRE
6. WILLINGNESS TO WORK OVERTIME AND OTHER THAN STANDARD SHIFT HOURS WHEN JOB DUTIES SO REQUIRE
7. THAT INITIAL EMPLOYMENT IS CONDITIONAL ON OBTAINING ACCEPTABLE CLEARANCE FROM DEPARTMENT OF DEFENSE WHEN JOB DUTIES SO REQUIRE
8. THAT EMPLOYMENT OF AT LEAST 15 YEARS SERVICE IS REQUIRED AT THE END OF THE MONTH IN WHICH AGE 65 IS REACHED TO QUALIFY FOR A SERVICE PENSION FROM THE WESTERN ELECTRIC COMPANY
9. TO CONFORM TO OTHER COMPANY RULES, REGULATIONS AND INSTRUCTIONS

IT IS UNDERSTOOD THAT IF EMPLOYED, FALSE STATEMENTS ON THIS APPLICATION SHALL BE CONSIDERED SUFFICIENT CAUSE FOR DISMISSAL

Signature of Applicant \_\_\_\_\_ First \_\_\_\_\_ Middle \_\_\_\_\_ Last \_\_\_\_\_ Date \_\_\_\_\_

Employment Interviewed \_\_\_\_\_ Name \_\_\_\_\_ Title \_\_\_\_\_ Date \_\_\_\_\_

Interviewer's Comments \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

278

- (2) Inability, in some cases, to apply vacuum tip and source of heat to the solder joint at the same time

- (3) Short vacuum duration or physical movement of vacuum tip caused by manual operation of the vacuum source may cause incomplete solder removal, necessitating multiple applications of heat which can result in damage

3. Motorized vacuum extraction

- a. Solder removal using motorized vacuum consists of a continuous vacuum source such as an airbottle and venturi combination or an electrically driven vacuum pump, which provides a continuous vacuum to a heated solder extraction tip and removes molten solder by vacuum airflow.

- a. Display Slide YXH L5-S19, "Motorized Vacuum Extraction"

516

515

## LEARNING ACTIVITY E

### JOB INTERVIEW

Objective: You will be able to identify conditions to be aware of during a job interview, including (a) ten questions which would typically be asked and (b) ten positive conditions or responses which would help you get the job.

Introduction: Nearly every successful job search includes an interview with a supervisor, personnel interviewer, or proprietor. It is the interview which affords both the employee and employer the chance to see if there is mutual advantage for working together. The main reason for the interview is to give the employer an opportunity to learn something further about the person applying for the position. Some of the traits the employer will be looking for are appropriate appearance, personality, attitude, skills and education.

The job interview is an important event in the average person's life. The twenty or thirty minutes a person spends with the interviewer may determine that person's entire future. Think about what you are going to do and say when certain questions are asked of you during the interview. Until now, you may have been thinking of the benefits which you will receive from a company. Instead, ask yourself the question, "What can I do for the company?" How do your skills, qualifications, training and previous work experience rate you as the person to fill the vacant position?

The following activity will help to prepare you for the job interview.

OUTLINE OF INSTRUCTION

- b. Motorized vacuum is normally controlled by a foot switch and differs from manual vacuum primarily in that it supplies a continuous vacuum
  
- c. Motorized vacuum extraction advantages
  - (1) The vacuum can generally be set at the desired level
  
  - (2) The extraction tip and the heat source are usually combined into one tool
  
  - (3) Availability of continuous vacuum allows solder removal with a single application of heat

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY



## Job Interview (Continued)

### WHAT TO DO IN AN INTERVIEW

Give your name, and the position for which you are applying. Remain standing until the interviewer asks you to be seated. You should say something like: "Good morning, Mr. James, my name is William Dennis and I am here to apply for the job of detail draftsman which was advertised in the Daily Messenger." If the interviewer offers to shake hands, be sure that your grip is firm but don't try to prove how strong you are by crushing the interviewer's hand. If you meet a receptionist, tell this person that you have an appointment with Mr. James and state the time of your appointment.

During the interview, always try to make the best impression possible. Stress both your interest in the work and your qualifications to fill the position. Never overemphasize your need for the job.

Always be positive. Never criticize or put down your previous employers. Let the person interviewing you lead the discussion. Stick to the point and be brief in your answers.

Hold your questions until the latter part of the interview. The interviewer will indicate when the interview is over. Be sure to express your appreciation for the consideration and time given to you. If a secretary introduces you to the interviewer, be sure to thank this person as you leave.



OUTLINE OF INSTRUCTION

- (4) Motorized vacuum sources  
may have a vacuum rise time  
which is slower than desired

C. Tools used to desolder printed circuit  
solder joints

1. Handtools

- a. Handtools normally used in  
desoldering printed circuit  
solder joints

- (1) Soldering iron

510

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

080

520

2-3-24

## Job Interview (Continued)

### VARIOUS WAYS TO AVOID BEING HIRED

(As reported by the Placement Office at New York University)

1. Poor personal appearance.
2. Overbearing, overaggressive, conceited, superiority complex.
3. Inability to express ideas clearly, using poor grammar.
4. Lack of planning for career; no purpose and goals.
5. Lack of confidence and poise; being ill at ease.
6. Lack of interest and enthusiasm with passiveness and indifference.
7. Failure to participate in activities.
8. Over emphasis on money; interested only in the dollar.
9. Poor scholastic record.
10. Unwilling to start at the bottom; expect too much too soon.
11. Makes excuses, evasiveness, hedges on unfavorable factors.
12. Lack of tact.
13. Lack of maturity.
14. Lack of courtesy, ill-mannered.
15. Condemnation of past employers.
16. Lack of social understanding.
17. Marked dislike for school work.
18. Fails to look interviewer in the eye.
19. Limp, fishy handshake.
20. Sloppy application.
21. Wants job only for a short time.
22. Lack of knowledge or specialization.
23. Little interest in the company or industry.
24. Inability to take criticism.



OUTLINE OF INSTRUCTION

(2) Wicking material

(3) Thermal shunts .

(4) Various types of pliers and  
tweezers

b. External flux should be used in  
conjunction with wire braid when  
desoldering by the wicking method

2. Power tools - SX-300 Solder Extraction  
System

3. Proper selection and use of tools  
and techniques

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1992-93P8

2-3-25

521

522

281

Job Interview (Continued)

REVIEW EXERCISE

Part I List ten questions which might typically be asked of you by the employer during the interview:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_

Part II Below are several situations or responses which could help you to get the job or could prevent you from being hired. Place a G (good) in front of the conditions which would help in getting the job and a P (poor) in front of the conditions which would hurt your chances of being hired.

1. \_\_\_\_ Hair uncombed
2. \_\_\_\_ "How much will this job pay?"
3. \_\_\_\_ Neat, printed application form.
4. \_\_\_\_ "I ain't never had any illnesses."
5. \_\_\_\_ "I was interested to hear of the expansion of your company into a new product line."
6. \_\_\_\_ Prompt, on time at interview.
7. \_\_\_\_ Limp hand shake.
8. \_\_\_\_ "It was hard to get along with my last employer."
9. \_\_\_\_ "I'm not sure I could do the job."
10. \_\_\_\_ "I'm willing to work hard at any assignment I'm given."

282

OUTLINE OF INSTRUCTION

a. The selection of tools and techniques to be used in a particular desoldering operation will be determined by the type of solder-joint and lead termination

b. The tools and techniques chosen MUST be those least likely to cause damage of any nature. To avoid damage, the following factors should be considered

(1) The effect of chosen technique on board material

(2) The effect of chosen technique on circuit conductors

INSTRUCTOR ACTIVITY

(1) Display Slide YXH L5-S20, "Selection and Use of Desoldering Tools"

STUDENT ACTIVITY

524

523

Posttest (Continued)

Circle T if statement is True, F if it is False

- T F 25. You should include your phone number in the application letter.
- T F 26. The inside address block is also your return address.
- T F 27. The date block is located in the upper right hand corner of the letter.
- T F 28. The body of the letter should be one continuous paragraph.
- T F 29. The salutation is the closing of the letter.
- T F 30. The signature should be typewritten.
- T F 31. Your letter should include grade point average and some important courses which you took.
- T F 32. Paragraph one should explain the purpose of the letter to the employer.
- T F 33. Your letter should include several references.
- T F 34. You should appear at the interviewer's office precisely on time.
- T F 35. You should bring your high school transcript along to the interview.
- T F 36. It is considered good practice to ask the interviewer the exact pronunciation of his/her name.
- T F 37. It is good to extend thanks to both the interviewer and receptionist.
- T F 38. After greeting the receptionist you should state your business and time of appointment.
- T F 39. Your own questions should be asked at the beginning of the interview.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(3) The effect of chosen technique on adjacent components

c. Testing and evaluation techniques effective and reliable applications.

c. Stress that the technician must decide which technique is best for a specific task, keeping in mind at all times the REQUIREMENT of causing NO damage

d. Methods of solder removal which should not be used or which have limited applications

d. Display Slide YXH L5-S21, "Inferior Methods of Solder Extraction"

(1). At the top left is an example of the heat and shake method which should not be used since it does not remove all solder, and it causes solder to be splattered over other areas of the circuit



ANSWER KEY - ACTIVITY A: VOCABULARY

1. one who applies for a job
2. a request or petition
3. make application for a job
4. to finish
5. clear, brief and to the point
6. to be refused a job
7. someone whom you support
8. actual involvement
9. discharged or asked to leave
10. a previous or past employer
11. to employ
12. spare time activity
13. a situation or employment
14. ability to write clearly and correctly
15. single, married, separated or divorced
16. Non Applicable
17. a particular field of work
18. to omit or leave out
19. refers to the individual
20. employees of a company
21. a person listed on the application form who will speak well of you.
22. members of your family
23. payment for services or work performed
24. a safe, steady job
25. husband or wife
26. your last name

### OUTLINE OF INSTRUCTION

- (2) At the top center is an example of the heat and pull method which should not be used, since hidden component lead terminations may cause damage when pulled
- (3) At the top right is an example of the heat and blow method which should not be used for the same reasons as the heat and shake method
- (4) At the bottom left is an example of using a squeeze-bulb solder extractor. This method is inferior due to the tip size, incomplete extraction and frequent solder spillage onto circuit

### INSTRUCTOR ACTIVITY

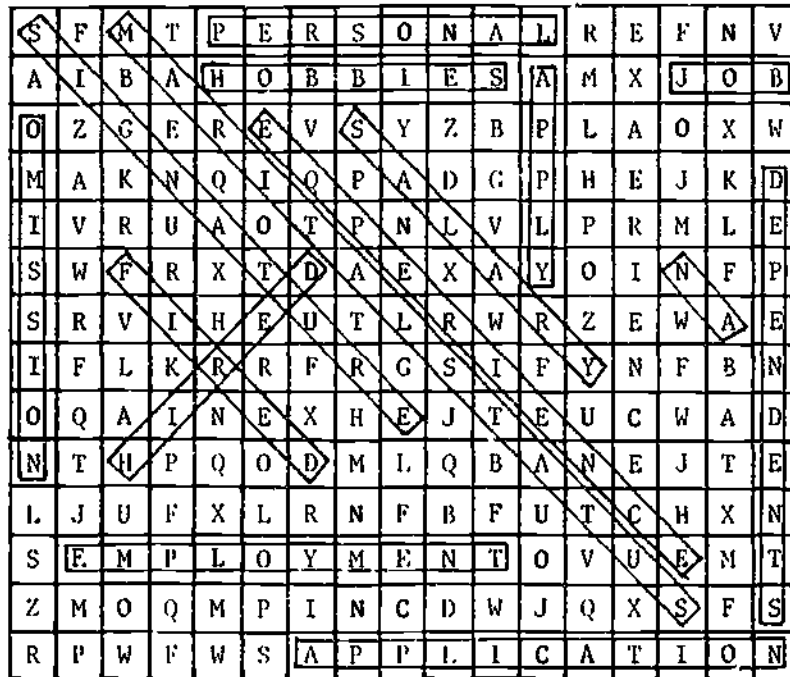
### STUDENT ACTIVITY

284

525

527

# ANSWER KEY - ACTIVITY A: ANAGRAM



## ANSWER KEY - ACTIVITY C: LETTER OF APPLICATION REVIEW

1. A letter of application is written by the applicant to a prospective employer for a position that is available.
2.
  - a. date block or heading
  - b. inside address
  - c. salutation
  - d. body
  - e. complimentary closing
  - f. signature
3.
  - a. be brief
  - b. write several drafts of the letter before you decide on a final one.
  - c. write the letter to a particular individual slanting it to his/her needs and policies.
  - d. be neat; use a pen with blue or black ink. A typewritten letter is best.
  - e. state a definite job; do not say you want "anything."
4. False
5. False
6. True
7. False
8. False
9. False
10. True

## ANSWER KEY - ACTIVITY D: APPLICATION FORM

Answers will vary. See your instructor

OUTLINE OF INSTRUCTION

(5) At the bottom right is an example of using a spring plunger extractor for solder removal. This method has limited application since it does not work well in small areas and does not remove all of the solder

e. Wicking method is used to remove surface solder. The wicking method works well in removing surface solders when the following procedures are used:

(1) Select a piece of wicking material (braid or stranded wire) which is smaller than the area being desoldered

INSTRUCTOR ACTIVITY

e. Display Slide YXH L5-S22, "Example of Wicking"

STUDENT ACTIVITY

1992-94P8

529

2-3-29

53.1

285

ANSWER KEY: PRETEST - POSTTEST

1. tells if you are single, married or divorced
2. a particular field of work
3. husband or wife
4. refers to you personally
5. a person listed on the application who will speak well of you.
6. one who applies for a job.
7. payment for services or work performed
8. writing clearly and correctly
9. your last name
10. employees of a company

Circled items are: 12, 16, 19, 20, 22, 23, 24.

- |           |  |
|-----------|--|
| 25. True  | 40. D  |
| 26. False | 41. I  |
| 27. True  | 42. A  |
| 28. False | 43. H  |
| 29. False | 44. E  |
| 30. False | 45. B  |
| 31. False | 46 - 49. These items will differ for each person. Please check with your instructor. |
| 32. True  |  |
| 33. False |  |
| 34. False |  |
| 35. False |  |
| 36. False |  |
| 37. True  |  |
| 38. True  |  |
| 39. False |  |

### OUTLINE OF INSTRUCTION

- (2) Dip the wicking material in flux and place on the area to be desoldered taking care to ensure that there is no overlap of wicking material onto the board material
- (3) As the slide shows, apply a clean, dry soldering iron tip to the braid using GENTLE pressure
- (4) The wicking material may be drawn across the area to be desoldered after the solder melts and begins to soak into the wicking material

### INSTRUCTOR ACTIVITY

- (3) Display Slide YXH L5-S23, "Soldering Iron Applied to Wicking Material"

### STUDENT ACTIVITY

286

531

531

OUTLINE OF INSTRUCTION

- (5) If solder stops flowing into the wicking material before it has all been removed, or if all of the flux is boiled away before removal is complete, the operation must be repeated, being sure to cut off the filled portion of the wicking material to provide a fresh wicking area for absorption of solder
- (6) Wicking material works progressively better as the number of strands increases and the size of the strands decrease
- (7) Damage can be caused by improperly using the wicking method

INSTRUCTOR ACTIVITY

- (7) Display Slide YXH L5-S24, "Results of Improper Wicking Procedures"

STUDENT ACTIVITY

533

534

287

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

288

(a) Scorching caused by excessive heat and allowing flux to completely boil away

(b) Measling caused by allowing hot wicking material to overlap the pad area and contact board material

f. A variety of manual vacuum extraction tools are available and perform with varying degrees of efficiency

(1) Squeeze-bulb solder sucker in operation.

(1) Display Slide YXH L5-S25, "Squeeze-bulb Solder Sucker" NOTE the difficulty of applying soldering iron tip and squeeze-bulb tip at the same time

535

535



OUTLINE OF INSTRUCTION

- (2) Successful solder removal operation using the squeeze-bulb.
- (3) Squeeze-bulb and soldering iron combined into one unit to overcome tip space disadvantages.
- (4) Solder spillage can occur with any of the squeeze-bulb type solder extractors

INSTRUCTOR ACTIVITY

- (2) Display Slide YXH L5-S26, "Successful Squeeze-Bulb Solder Removal" NOTE that it was performed on a large surface solder joint with an unclined lead termination
- (3) Display Slide YXH L5-S27, "Squeeze-Bulb and Soldering Iron in one Unit" NOTE the difficulty of handling and the ceramic tip (which must be extremely hot because ceramic has very poor heat transfer characteristics)
- (4) Display Slide YXH L5-S28, "A Disadvantage of Squeeze-Bulb Solder Extractors"

STUDENT ACTIVITY

535

289

### OUTLINE OF INSTRUCTION

- (5) Solder extractor with a bladder (squeeze-bulb) installed inside the handle

- (6) Solder spillage caused by insufficient vacuum to draw the solder completely into the chamber

- g. The most efficient manual vacuum solder extractor is one which uses a spring-loaded piston to create a vacuum. The following are the proper techniques for its use.

- (1) Apply the soldering iron tip and the extractor tip to the area to be desoldered at the same time.

### INSTRUCTOR ACTIVITY

- (5) Display Slide YXH L5-S29, "Internal Bladder Solder Extractor" NOTE the distance removed solder must travel

- (6) Display Slide YXH L5-S30, "A Disadvantage of Internal Bladder Solder Extractors"

- (1) Display Slide YXH L5-S31, "Spring Plunger Solder Extractor" NOTE that space is a very limiting factor

### STUDENT ACTIVITY

290

540

539

OUTLINE OF INSTRUCTION

- (2) Upon observing a complete solder melt, press the release trigger which will create a vacuum and cause the solder to be extracted
- (3) The extractor must be firmly held to minimize recoil which may cause the extractor tip to jump away from the joint and result in incomplete extraction and the necessity of repeating the operation several times, with resulting board damage
- (4) This method will NOT remove 100% of the solder and may cause circuit pad lifting on single-sided boards due to the extremely high vacuum which is generated

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

292

- (5) Proper care of this tool to maintain efficient operation requires that it be disassembled and cleaned thoroughly on a regular basis

- h. The most efficient and versatile of all solder extraction methods is the motorized vacuum method

- i. Old style of motorized vacuum extractor (the vacuum source/motor unit is not shown) with a piggy-back solder trap chamber.

1. Display Slide YXH L5-S32, "Obsolescent Motorized Vacuum Extractor"  
NOTE the large heated mass in close proximity to components which is one of its several disadvantages

514

513

OUTLINE OF INSTRUCTION

- k. No solder baffle in the old-style solder trap tube to prevent solder buildup in the airflow exit and the chamber, which becomes very hot during use, is exposed to operator contact. This unit is also unusable for special applications which required pressure rather than vacuum since there is no positive lock on the end caps

- l. Shown (without the motorized vacuum supply unit) is the improved solder extractor used with the SX-300 system. Note the following improvements:

- (1) In-line extraction path allowing solder to be pulled directly into the solder trap chamber

INSTRUCTOR ACTIVITY

- k. Display Slide YXH L5-S34, "Disadvantages of Old-Style Solder Trap Chamber"

- l. Display Slide YXH L5-S35, "SX-300 Solder Extractor"

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

h68

(2) Positive locking mechanism for chamber end caps allowing unit to be used for both pressure and vacuum

(3) Long thin heating element allowing access to confined areas

(4) The operator is protected from contact with the hot glass solder trap chamber since it is installed within the plastic handle

m. Motorized vacuum extraction method to achieve maximum effectiveness and minimum workpiece degradation

513

517

### OUTLINE OF INSTRUCTION

- n. Extractor tip must be positioned to allow maximum airflow through the soldered connection for best results. In a dead end hole situation, the majority of the solder is removed with vacuum and the remainder is blown out with pressure. To prevent sweat joints between component leads and circuit conductors, a stirring motion of the lead with the extractor tip MUST be used

- (1) A sweat joint is a paper-thin solder joint formed by the minute amount of solder remaining on conductor and lead surfaces which cannot be removed by extraction

### INSTRUCTOR ACTIVITY

- n. Display Slide YXH L5-S86, "Motorized Vacuum Extraction Techniques"

### STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

- (2) To properly prevent sweat joints from forming, the lead must be moved in a stirring motion as soon as the solder has completely melted and before vacuum is applied. The stirring motion must be maintained during the vacuum application and kept up until the airflow has caused the solder to cool and solidify.

NOTE: During the stirring action, the extractor tip MUST NEVER CONTACT ANYTHING EXCEPT THE SOLDER AND THE LEAD ITSELF since contact with circuit conductors will nearly always cause damage

- o. Lead and hole size have several factors affecting solder extraction

### INSTRUCTOR ACTIVITY

- o. Display Slide YXH L5-S38, "Selecting Extractor Tip Diameters"

### STUDENT ACTIVITY

296

551



### OUTLINE OF INSTRUCTION

(1) The amount of space between lead and sides of hole will affect extraction efficiency by varying the airflow through the hole

(2) The depth of the hole will determine length of time heat must be applied for complete solder melt

p. Both inside and outside diameters of extractor tips must be considered when selecting a tip

(1) Inside diameter is determined by the component lead diameter over which it must fit

### INSTRUCTOR ACTIVITY

p. Display Slide YXH L5-S37, "Effects of Lead Clearance and Hole Size"

### STUDENT ACTIVITY

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

368

(2) Outside diameter is determined by size and mass of pad

q. Extractor tips may be modified to fit over various lead terminations as shown

q. Display Slide YXH L5-S39, "Modifying Extractor to Fit Lead Termination"

r. Modified extractor tip to remove solder

r. Display Slide YXH L5-S40, "Using Modified Tip"

s. Modifying extractor tips to fit small or low-mass pads

s. Display Slide YXH L5-S41, "Modifying Extractor Tip to Fit Small or Low-Mass Pads"

556

555

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
(1) A ball mill is inserted inside the tip and used with the rotary tool as a turning and holding device		
(2) A file is used to shape the tip to the desired form		
t. Comparison of modified and unmodified extractor tips. The exposed copper on the modified tip should be tinned to prevent oxidation and improve heat transfer	t. Display Slide YXH L5-S42, "Standard and Modified Extractor Tips"	
u. The quality of solder extraction attainable by using the proper techniques is plainly shown in this slide	u. Display Slide YXH L5-S43, "Results of Proper Solder Extraction Technique"	
	2-3-43	

OUTLINE OF INSTRUCTION

v. SX-300 Solder Extractor

- (1) Master power switch and indicator
- (2) The footswitch which is permanently attached and controls the vacuum supply motor
- (3) The twist-lock vacuum and pressure fittings

INSTRUCTOR ACTIVITY

- v. Display Slide YXH L5-S44.  
"SX-300 Solder Extractor"  
Instructor use SX-300  
slide to point out and  
describe the operation  
and controls

STUDENT ACTIVITY

300

560

550

OUTLINE OF INSTRUCTION

- (4) The vacuum and pressure control valves which the operator must adjust for the particular extraction situation

- (5) The variable AC plug-ins and their controls

NOTE: The extractor hand-piece (element and tip) will attain a temperature of approximately 1,000 degrees at maximum setting of the variable AC control and MUST be used with EXTREME CAUTION. The temperature MUST be properly adjusted for each particular task to avoid causing overheating damage to the workpiece

- (6) The hot cubby and its functions

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

7

OUTLINE OF INSTRUCTION

- (a) The soldering iron and extractor holders
  
- (b) The molten solder trap used to clear the extractor tip of molten solder prior to using the extractor in the pressure mode
  
- (c) The wiping brush used to remove excess solder from the top of the soldering iron providing what is known as a "dry iron"

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

302

594

503

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

- (d) The wet thermal shocking sponge used to clean oxides from the "dry" iron tip resulting in a "clean" iron tip. The wet sponge is NOT to be used for removing excess solder from the iron tip as its purpose is to remove oxides by causing the tip to rapidly and violently contract, thereby loosening any oxides which will then be removed by the wiping action

D. Component removal after solder extraction

1. Straight-through terminations allow the component to be lifted gently from nonconformal coated boards

### OUTLINE OF INSTRUCTION

2. The various clinched style terminations may require the breaking of a sweat joint which may be done by gripping the lead with pliers or tweezers and rotating the clinched portion approximately 30 degrees parallel to the board surface

3. After breaking the sweat joint the lead may be lifted gently to a straight position

NOTE: Do NOT attempt to lift or straighten the lead until the sweat joint is broken

4. After the component lead is completely free and straight remove the component from a conformal coated board by

### INSTRUCTOR ACTIVITY

2. Display Slide YXH L5-S45, "Freeing Clinched Leads"

### STUDENT ACTIVITY

304

508

507



### OUTLINE OF INSTRUCTION

- a. Heating the component with a soldering iron tip or by blowing hot air from the solder extractor (preferred method)

NOTE: Use EXTREME CAUTION not to cause heat damage to the workpiece

- b. After any residual coating is softened by heat, grip the component gently with a pair of tweezers or pliers and free it from the coating with a gentle side-to-side rocking motion

- c. At this point the component may be lifted carefully from the board

- E. Evaluating individual workpieces to determine proper techniques for desoldering and removing components

### INSTRUCTOR ACTIVITY

- a. Display Slide YXH L5-S46, "Freeing Component From Coating"

### STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

1. A careful, thorough physical examination must be made to determine the solder-joint characteristics, most effective desoldering technique, and the tools to be used in applying these techniques
  2. A careful step-by-step analysis of the task as it is performed MUST take into consideration possible hidden characteristics
- F. Inspecting completed work for damage to circuit board or remaining components
1. Board damage

### INSTRUCTOR ACTIVITY

- I. Display Slide YXH L4-S47,  
"Component Desoldering  
and Removal Evaluation"
- F. Display Slide YXH L5-S48,  
"Desoldering and Removal  
Task Completion Inspection"

### STUDENT ACTIVITY

306

572

571

2-3-50

Published  
by  
TRADE AND INDUSTRIAL EDUCATION SERVICE  
Division of Program Services  
Vocational and Adult Education  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216

Developed with the cooperation of  
Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24061

Conducted under  
Vocational Education Amendments of 1976  
P. L. 96-482

PROJECT DIRECTOR:	Lester G. Duenk
Workshop Instructor:	Robert P. Braden
Editors:	Ben L. Baines Richard Lee Ross
Writers:	Herbert G. Carpenter Walter Chernenko

Single copy available from:

Public Information and Publications Office  
Virginia Department of Education  
Richmond, Virginia 24061

Order No. LAP 5

Price \$2.25 each

As required by federal laws and regulations, the Virginia Department of Education does not discriminate on the basis of sex, color, race, religion, handicapping conditions, or national origin in employment or in its educational programs and activities.

The activity which is the subject of this report was supported in whole or in part by the U. S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position of policy of the U. S. Office of Education, and no official endorsement by the U. S. Office of Education should be inferred.

EMPLOYER-EMPLOYEE RELATIONS

Learning Activity Package



For use with  
Industrial Cooperative Training Programs

TRADE AND INDUSTRIAL EDUCATION SERVICE  
Division of Program Services  
Vocational and Adult Education

S. John Davis  
Superintendent of Public Instruction  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216

May 1980

- | <u>OUTLINE OF INSTRUCTION</u>   | <u>INSTRUCTOR ACTIVITY</u> | <u>STUDENT ACTIVITY</u> |
|---|----------------------------|-------------------------|
| a. Scorching or charring caused by component failure or improper repair techniques  |                            |                         |
| b. Measling which is the appearance of white spots that are small areas of the fiber glass strands which have been exposed by heat, abrasive, or solvent action |                            |                         |
| c. Possible cracks or breaks in the board material  |                            |                         |
| 2. Conductor damage   |                            |                         |
| a. Any missing pads or conductors   |                            |                         |

## INTRODUCTION

What must I do to be successful on my job? This question whirls through the minds of many young people who are starting out in the world of work. This Learning Activity Package (LAP) will aid you in developing a good employer-employee relationship. You will have an opportunity to see things from the employer's point of view. Knowing what your employer expects of you can be half of the battle in being successful on your job. Your general abilities, personal qualities, work traits and attitudes must be considered. It is essential to realize that your work record will determine the opportunities for advancement in your chosen occupation.



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

308

b. Any nicked or cracked conductors

c. Lifted or delaminated pads or conductors

3. Component damage

a. Cracked, broken, or overheated components

b. Deformed or broken component leads

c. Poor solder joints and loose or splashed solder which may cause shorts

576

575

'2-3-52

PRETEST

Circle T if the statement is True, F if it is False.

- T F 1. Most first-time employees are fired because of their lack of skill on the job.
- T F 2. Tact is describing the way one dresses.
- T F 3. Your attitude is one of your most important personality traits.
- T F 4. Most employers are concerned with the way you look and dress.
- T F 5. Your desire to get ahead on your job will be looked upon favorably by your employer.
- T F 6. It is helpful to know which traits your employer considers important.
- T F 7. Getting along with others is learned rather than accidental.
- T F 8. The attitudes which people have are a result of their outlook on life.
- T F 9. Initiative means honesty and truthfulness.
- T F 10. Persons who are hard working are assured of keeping their jobs.

Match the words in the right hand column with the correct definition in the left hand column.

- |  |                 |
|--|-----------------|
| _____ 11. Code of behavior                   | A. Consistency  |
| _____ 12. Ability to keep a level head       | B. Courtesy     |
| _____ 13. Harmony of conduct                 | C. Adaptability |
| _____ 14. Being a self-starter               | D. Integrity    |
| _____ 15. Desire to achieve                  | E. Optimism     |
| _____ 16. Consideration toward others        | F. Initiative   |
| _____ 17. To expect a favorable outcome      | G. Poise        |
| _____ 18. Promptness, exactness, preciseness | H. Ambition     |
| _____ 19. Show lively interest               | I. Productivity |
| _____ 20. Ability to conform to a situation  | J. Enthusiasm   |
|  | K. Cooperation  |
|  | L. Punctuality  |
|  | M. Self-control |



OUTLINE OF INSTRUCTION

G. Safety precautions

1. Workpiece

- a. Never perform any action on the workpieces which will cause damage or degradation
- b. Handle all workpieces as extremely fragile
- c. Maintain scrupulous cleanliness at all times

2. Tool

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

Pretest (Continued)

- (8) \_\_\_\_\_
- (9) \_\_\_\_\_
- (10) \_\_\_\_\_
- (11) \_\_\_\_\_
- (12) \_\_\_\_\_
- (13) \_\_\_\_\_
- (14) \_\_\_\_\_
- (15) \_\_\_\_\_

27. Name and explain ten causes for losing your job.

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- (3) \_\_\_\_\_
- (4) \_\_\_\_\_
- (5) \_\_\_\_\_
- (6) \_\_\_\_\_
- (7) \_\_\_\_\_
- (8) \_\_\_\_\_
- (9) \_\_\_\_\_
- (10) \_\_\_\_\_

28. List three of your work attitude strengths and three of your work attitude weaknesses. Indicate how you will correct your weaknesses.

Strengths

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- (3) \_\_\_\_\_

Weaknesses

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- (3) \_\_\_\_\_

OUTLINE OF INSTRUCTION

- a. Properly clean all tools and store  
in proper place

(1) Special care is necessary in  
maintaining the SX-300 Solder  
Extraction systems

(2) Proper removal of the glass  
chamber is shown in this  
slide. Use a gentle push-  
turn motion to release the  
retaining cap and carefully  
withdraw the glass chamber  
to avoid breakage

(3) Bristle brush is used to clean  
the glass chamber after  
carefully pushing out the  
metal baffle and the cotton  
vapor trap. A light coating  
of mineral oil will aid in  
future cleaning.

INSTRUCTOR ACTIVITY

(1) Display Slide YXH L5-S49,  
"Removing Glass Chamber"

(3) Display Slide YXH L5-S50,  
"Cleaning Glass Chamber"

STUDENT ACTIVITY

310

580

579

2-3-54

LEARNING ACTIVITY A  
TRAITS WHICH EMPLOYERS SEEK

Objective: You will be able to demonstrate a knowledge of twenty basic points of desirable and undesirable employee traits.

Introduction: Following is a list of traits which are characteristic of the good employee. Use a dictionary to familiarize yourself with the meaning of these traits. Write the definition to these traits in the spaces provided. You may refer to these definitions as needed to complete subsequent sections.

1. Adaptability \_\_\_\_\_  
\_\_\_\_\_
2. Ambition \_\_\_\_\_  
\_\_\_\_\_
3. Cheerfulness \_\_\_\_\_  
\_\_\_\_\_
4. Cooperation \_\_\_\_\_  
\_\_\_\_\_
5. Consistency \_\_\_\_\_  
\_\_\_\_\_
6. Courtesy \_\_\_\_\_  
\_\_\_\_\_
7. Dependability \_\_\_\_\_  
\_\_\_\_\_
8. Enthusiasm \_\_\_\_\_  
\_\_\_\_\_
9. Honesty \_\_\_\_\_  
\_\_\_\_\_

### OUTLINE OF INSTRUCTION

(4) The extractor element is cleaned with the small wire brush after the tip is removed. Cleaning and tip removal must be performed AT LEAST once daily, (8 hours operation) and the extractor shall be stored with the tip removed.

(5) For periodic and unscheduled maintenance of the SX-300 power and vacuum supply refer to the equipment handbook.

b. Never use excessive force on any tool

c. Use each tool only in the manner for which it was designed to be used

### INSTRUCTOR ACTIVITY

(4) Display Slide YXH L5-S51, "Cleaning Extractor Element"

### STUDENT ACTIVITY

Traits Which Employer Seek (Continued)

In the blanks at the left, fill in the letter of the matching definition.

- |           |  |    |               |
|-----------|--|----|---------------|
| _____ 1.  | Code of behavior, honesty                          | A. | Motivation    |
| _____ 2.  | Do or say the kindest or most fitting thing        | B. | Cooperation   |
| _____ 3.  | Ability to keep a level head                       | C. | Adaptability  |
| _____ 4.  | Reliability  | D. | Productivity  |
| _____ 5.  | Tidiness, clean condition                          | E. | Poise         |
| _____ 6.  | Happiness, joyfulness                              | F. | Initiative    |
| _____ 7.  | Harmony of conduct                                 | G. | Consistency   |
| _____ 8.  | Being a self-starter                               | H. | Enthusiasm    |
| _____ 9.  | Creation of goods and services                     | I. | Loyalty       |
| _____ 10. | Work together toward a common end                  | J. | Cheerfulness  |
| _____ 11. | Desire to achieve                                  | K. | Punctuality   |
| _____ 12. | Consideration toward others                        | L. | Neatness      |
| _____ 13. | To expect a favorable outcome                      | M. | Honesty       |
| _____ 14. | Fairness of conduct, trustworthiness, truthfulness | N. | Dependability |
| _____ 15. | Promptness, exactness, preciseness                 | O. | Optimism      |
| _____ 16. | Faithfulness                                       | P. | Self-control  |
| _____ 17. | Show lively interest                               | Q. | Courtesy      |
| _____ 18. | Self-possessed composure, assurance and dignity    | R. | Tactfulness   |
| _____ 19. | Ability to conform to a situation                  | S. | Ambition      |
| _____ 20. | Stimulation toward action                          | T. | Integrity     |

OUTLINE OF INSTRUCTION

- d. Check all electrical cords for damage from hot tools, solvents or abrasion

3. Personal

- a. Beware of burns from hot tools (keep tools in holders provided)
- b. Avoid prolonged skin contact and excessive breathing of chemicals and fumes
- c. Beware of flammable chemicals and materials

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

3/2

584

583

## LEARNING ACTIVITY B

### WHAT IS MY WORK ATTITUDE?

Objective: You will be able to rate yourself accurately on fifteen work related attitudes.

Introduction: Self-evaluation allows us to see ourselves as others do. The following exercise requires you to evaluate yourself by reacting to a list of questions about yourself. Read the questions carefully and give an honest opinion about yourself.





<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUOENT ACTIVITY</u>
III. <u>APPLICATION</u>		
A. Performance Test 2.3	A. Supervise each student's completion of performance test, emphasizing safety.	A. Complete performance test 2.3. Ask questions if procedures are not clear.
IV. <u>SUMMARY</u>		
A. Introduction	A. Emphasize importance of the summary for the student	
1. Nature of summary		
2. Purpose of summary		
B. Directions to students		

What Is My Work Attitude? (Continued)

- \_\_\_\_\_ 17. Can you disagree without becoming angry?
- \_\_\_\_\_ 18. Are you a patient person?
- \_\_\_\_\_ 19. Can you follow rules of the company easily?
- \_\_\_\_\_ 20. Are you self-confident?
- \_\_\_\_\_ 21. Can you work with people you dislike?
- \_\_\_\_\_ 22. Do you make excuses every time something goes wrong?
- \_\_\_\_\_ 23. Do you make and hold long-term friendships?
- \_\_\_\_\_ 24. Do you finish unpleasant tasks easily and without question?
- \_\_\_\_\_ 25. Are you completely honest?
- \_\_\_\_\_ TOTAL

There are 25 questions; a perfect score would be 125. Total your score and rate yourself according to the following scale:

115 - 125 You are an unbelievable person.

90 - 114 Your attitude is very commendable.

75 - 89 You need some improvement in certain areas of attitude.

Below 75 You need to re-examine your attitude toward others.

Are you satisfied with yourself? Where do you feel you need improvement?

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
1. Questions		
2. Notes		
C. Recap of lesson	C. Emphasize safety	C. Ask questions if material not clear; check notes to insure accuracy and completeness
V. <u>INFORMAL TEST</u>		
A. There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application"		
VI. <u>ASSIGNMENT</u> 587	VI. Provide students with the homework assignment	VI. Ask questions if the assignment is unclear. Complete assignment.
2004-05P8	2-3-58	588

314

## Desirable Personal Qualities (Continued)

Try to be the kind of person who is active, prompt and alert. Surely you cannot expect success on the job if you are sleepy, ailing and listless much of the time.



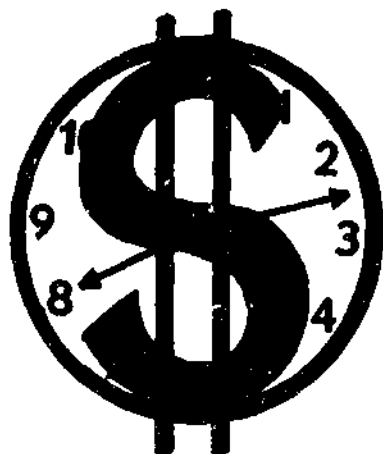
### THE DEPENDABLE WORKER

Employers naturally are interested in having their company make a profit. If you habitually come late to work, or skip days whenever you wish, it affects production and company profits. The late worker may say, "What

difference does a few minutes make?"

This question can be answered by asking yourself, "What if everyone came to work ten minutes late?"

Obviously this would add up to a lot of lost time. The company could eventually "go broke" due to increased costs.



The worker who is continually absent slows down production and costs the company money. Not only does the undependable worker cost the company money, but morale among other workers also suffers. What is fair for one is fair for all. If others see that a few people can get away with being late or absent for work, they will feel hurt and resentful.

### THE QUIET, EFFICIENT WORKER

The skillful worker always does his/her work in the easiest, shortest way possible. This kind of worker does not waste words nor motions. There is

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M)  
Program A-100-0034

Lesson Topic 2.4:  
Repair of Damaged Printed Circuit Boards

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 3.0 Hours  
Laboratory - 8.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides YXH -L6 1 Thru YXH-L6-S58

3. Training Aids Equipment

- a. Projector, Slide
- b. Screen, Projection, Standard

4. Text

- a. Student's Guide

5. References

- a. MIL-STD-454D
- b. MIL-STD-275C

TERMINAL OBJECTIVES:

Supported Partially by this lesson topic:

- 4.0 REPAIR damaged printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in MIL-STD-454D.

ENABLING OBJECTIVES:

When you complete this lesson topic, you will be able to:

- 2.4.1 IDENTIFY the four categories of damage common to printed circuit boards as identified in MIL-STD-275C and 454D.
- 2.4.2 DETERMINE the extent of repair required and proper repair techniques to be used on any printed circuit board in accordance with information contained in MIL-STD-275C and 454D.
- 2.4.3 REPAIR damaged printed circuit board laminates, conductors and eyelets using the proper tools and techniques and to the standards outlined in MIL-STD-275C and 454D.

CRITERION TEST

On Assignment Sheet 2.4.1 the student will identify the four categories of circuit board damage without error.

## Desirable Personal Qualities (Continued)

### THE CHEERFUL, COURTEOUS WORKER

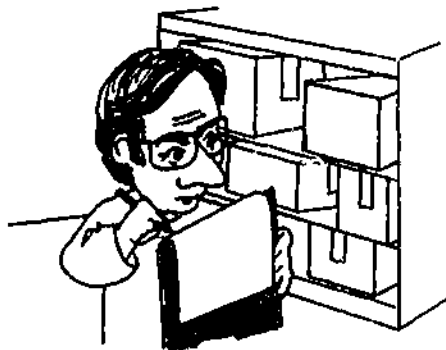
Have you ever stopped to think how your moods affect others around you? It always brightens up your day when you can work near someone who is happy and cheerful. Make it a point to wake up in the morning with a smile and then spread that cheerfulness to others throughout the day. If you feel happy inside, you are less likely to say unkind words or spread gossip. Not only will others like you more than if you were not cheerful, but your employer will soon observe how your cheer lifts the morale of the entire group.



The same can be said about courtesy -- it is catching. Use the words "thank you", "please" and "excuse me" liberally. Show others that you respect their feelings and the same courtesies will soon be extended to you.

### THE DETERMINED WORKER

To be determined is to be willing to stick to a task until completed. Someday you will no longer be under the watchful eye of your teacher or



your parents. There may be no one to force you to do the job. In the world of work you will discover that you either produce on your own or lose your job. You will need to learn to manage yourself.

Given selected circuit boards the student will DETERMINE the extent of repair required and repair damaged printed circuit board laminates, conductors and eyelets following procedures outlined on Performance Sheet 2-4-1P and to the standards outlined in MIL-STD-454D & 275C.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
I. <u>INTRODUCTION</u>		
A. Contact	A. Introduce self and topic. Provide for students needs:	
	1. Muster	
	2. Comfort	
	3. Visibility and seating	
B. Readiness	B. Explain value of subject matter, pointing out where appropriate, its relationship to the following:	

592

593

317



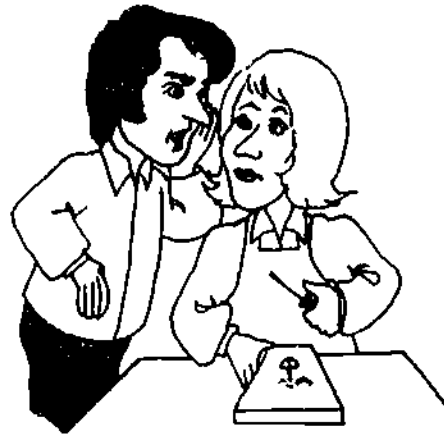
LEARNING ACITIVITY D  
SURE WAYS OF LOSING YOUR JOB

Objective: You will be able to recognize and explain ten probable causes for job termination.

Introduction: Many employees who lose their jobs never fully realize the reasons which led to their dismissal. You can insure yourself against the possibility of this happening to you if you become aware of the traits which could cost you your job.

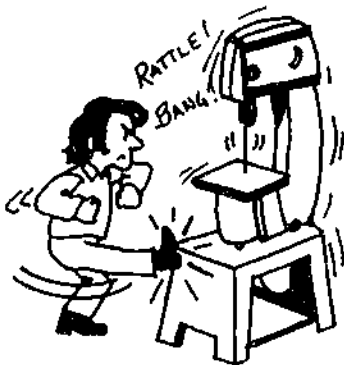
GOSSIPING

Gossip is a great wrecker of team work. The person who gossips continually is indirectly responsible for lowered production and employee turnover. If one of your co-workers seeks to ruin another person's character, the best thing to do is to ignore it. Never repeat hurtful or unpleasant things about others.



CARELESS WITH TOOLS AND EQUIPMENT

In most jobs the employer furnishes the tools and equipment which you will use. If you are careless with such equipment, repair or replacement may be very expensive. One careless moment could wreck a machine worth thousands of dollars. Always treat the employer's equipment as if it were your own.



## Sure Ways of Losing Your Job (Continued)

### DISHONESTY

Employers want employees who can be trusted without requiring constant supervision. Usually dishonesty is discovered after a short time. If theft or deception is given as the reason for dismissal it may be very difficult to gain another job.



Remember that a future employer will ask for references from your previous place of employment.

### CANNOT FOLLOW DIRECTIONS

Are you the kind of person who can be expected to do the job correctly



after being told once what to do, or are you the kind of employee who does not listen attentively and who constantly requires direction? Develop the habit of following directions exactly and doing the job right the first time.

### POOR ATTITUDE TOWARD THE JOB

A person in this category is generally a faultfinder. This kind of worker complains about the tools, the boss, the pay raise which he/she should have received, and dozens of other things. Usually this kind of worker has a poor attitude toward life in



OUTLINE OF INSTRUCTION

INSTRUCTDR ACTIVITY

STUDENT ACTIVITY

318

1. Accomplishment of daily tasks aboard ship.

2. ✓ The necessity of the skills and techniques in repair of printed circuit boards.

3. Personal applications of the knowledge and skills.

4. Seek to motivate. Tell a good tie-in story if possible.

595

594

## Sure Ways of Losing Your Job (Continued)

is watching the time clock for the second hand to go around. Putting in your full time on the job is a way of showing that you are interested in your work.



### DISLOYAL TO THE COMPANY

Remember that your company is providing you with the money to support your standard of living. If you continually say things about the company which are hurtful, or if you "knock" the product or services, the word will soon get back to management. Always support the company or business that supports you.



### LOAFS ON THE JOB

Employers are not interested in keeping employees who are not willing to do their share of the work. Remember, if you loaf on the job, someone else must make up for the lost production time. Time is money in any business and employers cannot afford to retain workers who do not carry their fair share.



### LATE TO WORK CONTINUALLY

The employee who is continually late for work is generally the same one who is is a clock watcher at quitting time. In assembly line types of employment

OUTLINE OF INSTRUCTION

C. - Effect

D. Overview

INSTRUCTOR ACTIVITY

C. When following a subject matter lesson topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).
2. Commend students for mastery of skills in previous lesson(s).

D. overview lesson by:

1. Stating learning objectives as contained on cover pages to this topic.

STUDENT ACTIVITY

CAN NOT GET ALONG WITH OTHER EMPLOYEES

Almost every one wants to be liked by others. The person who cannot get



along with co-workers usually does not really know what is wrong. If you have trouble getting along with others at work and at school it might be a good idea to start thinking about how you can change the situation. Are you bossy? Do you tease others? Are you

a show-off? Try to figure out what is wrong and do something about it.

Employers will not retain employees who continually "stir up" trouble or cause ill feelings among co-workers.

DISREGARDS SAFETY RULES

Every employer has safety rules which must be followed. Taking chances is foolish because it will eventually lead to injury as well as loss of earning power. Your employer not only loses money because of lost production but also due to the added cost of workmen's compensation



insurance. The worker who constantly defies safety rules is a bad risk for any employer.

UNDEPENDABLE

The undependable worker very often practices one or more of the poor attitudes discussed previously, such as poor work attendance, clock watching or being

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

2. Stating procedures to be followed during the lesson.

a. Taking notes

b. Asking questions

c. Use of criterion test

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives or procedures if in doubt.

598

320

599

## Sure Ways of Losing Your Job (Continued)

In the working relationship, combinations of several undesirable qualities can lead to loss of your job. The previous reading contained sixteen reasons for being fired. Read and evaluate these reasons to see if any are descriptive of your own work habits. List in order, what you would consider to be the top six reasons for people being fired. Next, interview two employers and have them list the six main reasons they would fire an employee. After comparing these lists, ask your ICT coordinator to provide you with the six reasons most frequently given for employee dismissal as was reported in a national survey. Compare your findings.

### Your Reasons:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_

### Employers' Reasons:

- |          |          |
|----------|----------|
| 1. _____ | 1. _____ |
| 2. _____ | 2. _____ |
| 3. _____ | 3. _____ |
| 4. _____ | 4. _____ |
| 5. _____ | 5. _____ |
| 6. _____ | 6. _____ |



## OUTLINE OF INSTRUCTION

### II. PRESENTATION

#### A. - Types of circuit board damage

##### 1. Four common categories of damage.

- a. Cracked boards
- b. Scorched, charred or deeply burned boards.
- c. Broken boards.

## INSTRUCTOR ACTIVITY

- A. Explain each type of damage and pass sample around class and answer questions.

## STUDENT ACTIVITY

- A. Students take notes, ask questions and watch slides.

Sure Ways of Losing Your Job (Continued)

Employee No. 4. Cindy Little is nineteen years old and has been with the company six months. She is single and quite attractive. She is most enthusiastic and wants to learn everything about the business. She accepts criticism well and always tries to please. She is quite frank in her dealings with co-workers and this has occasionally caused friction. Her employer has some doubts concerning Cindy's ability to handle money. Quite a mix-up occurred when she handled the office charity fund.

Employee No. 5. Betty Brown is thirty-one years old. She has been with the company for four years. Betty is a loner. She keeps to herself most of the time. Her co-workers have learned to avoid her because she does not seem friendly. She says little and never smiles. The management is happy with the quality of her work and her dependability.

Employee No. 6. Bob Bentley has worked for six years in the shipping department. Bob tends to be quite careless with tools and equipment. During the past six months he has been injured three times. On one occasion he injured his back trying to lift a heavy crate by himself. Later he injured his foot when he came too close to a crate being unloaded by a forklift. Last week he pushed a screwdriver into his left hand while prying off a tie strap. Everyone likes Bob and he is very conscientious in doing his job. He lost fourteen work days during the last six months, all covered by workmen's compensation.

OUTLINE OF INSTRUCTION

d. Delaminated circuit board layers

2. Determining extent of damage.

a. Cracked boards

(1) Length and depth of crack must be determined by physical inspection.

(2) Disruption to conductors and components caused by crack must be determined.

602

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

322

603

## LEARNING ACTIVITY E

### WHAT ARE YOUR STRENGTHS AND WEAKNESSES?

Objective: You will be able to evaluate your own work attitudes and work skills by listing three strengths and three weaknesses and developing a program for correcting areas of weaknesses.

Introduction: It is normal to strive for security and comfort in life. In order to reach that goal you must use your inner strength and know your weaknesses. There is no reason to be afraid of your weaknesses. If you recognize these weaknesses and are willing to deal with them you will have come a long way. By really knowing yourself and understanding both your strengths and weaknesses you will be in a better position to improve yourself. If, on the other hand, you "wear a mask" and try to blame others for your weaknesses, you will have created another road-block. It will then appear to others that you are "out of touch" with yourself or "haven't gotten yourself together". Be honest with yourself. Try to recognize both your strengths and weaknesses. "Blaming the other person" whenever you have problems on the job is not going to benefit you in the long run. The following activities will help you in looking at your own work attitudes and skills.



OUTLINE OF INSTRUCTION

- (3) Care must be taken in examining cracked boards not to cause additional damage.
- b. Scorched, charred or deeply burned boards.
- (1) Determine the area of the board affected by discoloration of the surface, molten or blacken conductors and burned, melted or blackened components.
- (2) Determine the depth of the affected area which may range from a slight surface discoloration to a gaping hole through the circuit board.

604

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

323

605

**EMPLOYER'S REPORT TO COORDINATOR  
INDUSTRIAL COOPERATIVE TRAINING  
High School**

Name of Student	Occupation	Training Station				Coordinator
Rating Elements	Excellent	Good	Fair	Poor	Additional Remarks	
Attitude (conduct, courtesy, etc.)						
Cooperation (team worker)						
Initiative (self-starter)						
Accepts Responsibility (reliable, etc.)						
Loyalty (for Company)						
Resourcefulness (good judgment, etc.)						
Response to Instruction or Criticism						
Interest in Occupational Goal						
Progress (knowledge, confidence, etc.)						
Quality of Work (accuracy, etc.)						
Production (quantity of work)						
Practices Safety (with equip., etc.)						
Attendance (notification of absence)						
Prompt and Ready for Work						
Personal Appearance						

General Remarks: \_\_\_\_\_

Date \_\_\_\_\_

Immediate Supervisor \_\_\_\_\_

Employer \_\_\_\_\_

Additional questions on back for supervisor

OUTLINE OF INSTRUCTION

c. Broken boards.

- (1) Determine if all parts of the board are present.
- (2) Determine if circuit conductors or components have been affected by the break.
- (3) Determine if the broken pieces may be rejoined reliably or if new pieces must be manufactured.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

324

607

606

## What Are Your Strengths and Weaknesses? (Continued)

Write down your five greatest strengths and five greatest weaknesses. For each weakness write a five step plan for improving yourself. Over the next year check yourself on a monthly basis and see how well you are doing.

My strengths:

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_



My weaknesses:

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_
3. \_\_\_\_\_  
\_\_\_\_\_
4. \_\_\_\_\_  
\_\_\_\_\_
5. \_\_\_\_\_  
\_\_\_\_\_





OUTLINE OF INSTRUCTION

d. Delaminated circuit board layers

(1) Determine area of delamination.

(2) Determine if circuit conductors or components have been affected by the delamination.

B. Circuit board repair techniques

INSTRUCTOR ACTIVITY

d. This type of damage, unless occurring in a limited area is beyond the capabilities of field tools and techniques and requires manufacture of a new board laminate.



B. Display slide YXH-L6-S3

STUDENT ACTIVITY

What Are Your Strengths and Weaknesses? (Continued)

4th Weakness \_\_\_\_\_

Five Step Plan

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

5th Weakness \_\_\_\_\_

Five Step Plan

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

OUTLINE OF INSTRUCTION

1. Patching

- a. Damage which does not extend completely through the circuit board may be repaired by the patching technique.
- b. The patching technique consists of the following steps:
  - (1) If the board is scorched, charred or burned, remove all discolored board material by abrasive methods.
  - (2) Repairable delaminations which do not extend to the edge of the circuit board should be but away by abrasive methods until no delaminated material remains.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

326

611

610

Posttest (Continued)

In the space to the left place the letter (A,B,C, or D) which identifies the best answer.

\_\_\_\_\_ 21. A loyal worker is:

- A. Honest in every way
- B. Dependable on the job
- C. Courteous and cheerful
- D. Supportive of the company.

\_\_\_\_\_ 22. Most employees are fired because:

- A. They cannot get along with others
- B. They do not have the proper skills
- C. They do not like their job
- D. They are "clock watchers"

\_\_\_\_\_ 23. When we talk about initiative we mean:

- A. Consideration toward others
- B. Promptness, exactness, preciseness
- C. Being a self starter
- D. Code of behavior

\_\_\_\_\_ 24. Another word for integrity is:

- A. Honesty
- B. Stubbornness
- C. Joyfulness
- D. Consideration toward others

\_\_\_\_\_ 25. Which of the following describes the tactful worker?

- A. Gets to work on time
- B. Expects a favorable outcome
- C. Always truthful
- D. Says the kind or fitting thing

26. Select any fifteen work attitudes and rate yourself in each.  
Rate by indicating E (excellent), F (fair), P (poor)

(1) \_\_\_\_\_

(2) \_\_\_\_\_

(3) \_\_\_\_\_

(4) \_\_\_\_\_

(5) \_\_\_\_\_

(6) \_\_\_\_\_

(7) \_\_\_\_\_

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
(3) Do not remove delaminated material if a repairable delamination exists which extends to the edge of the printed circuit board.		
(4) After removing all damaged board material, bevel and/or undercut the edge of the removed area to provide physical holding points for the repair material.		
(5) Clean thoroughly with solvent to remove all loose particles.		
(6) Mix a compound of epoxy and powdered fiber glass and fill the cutaway area with this compound, being EXTREMELY careful to leave no voids or air bubbles.		

Posttest (Continued)

How to correct my weaknesses

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- (3) \_\_\_\_\_

OUTLINE OF INSTRUCTION

- (7) Level the surface of the filled-in area being sure that the surface of the fill material is no lower than the original board surface.

- (8) In the case of delaminations on the edge of a board, fill the delaminated layers COMPLETELY with the repair mixture and clamp firmly together between two flat surfaces.

- (9) Cure the epoxy repair mixture completely as per the manufacturer's instructions found on the package.

INSTRUCTOR ACTIVITY

- (7) NOTE: Epoxy will not stick to plastic used.

- (8) Stress this point.

STUDENT ACTIVITY

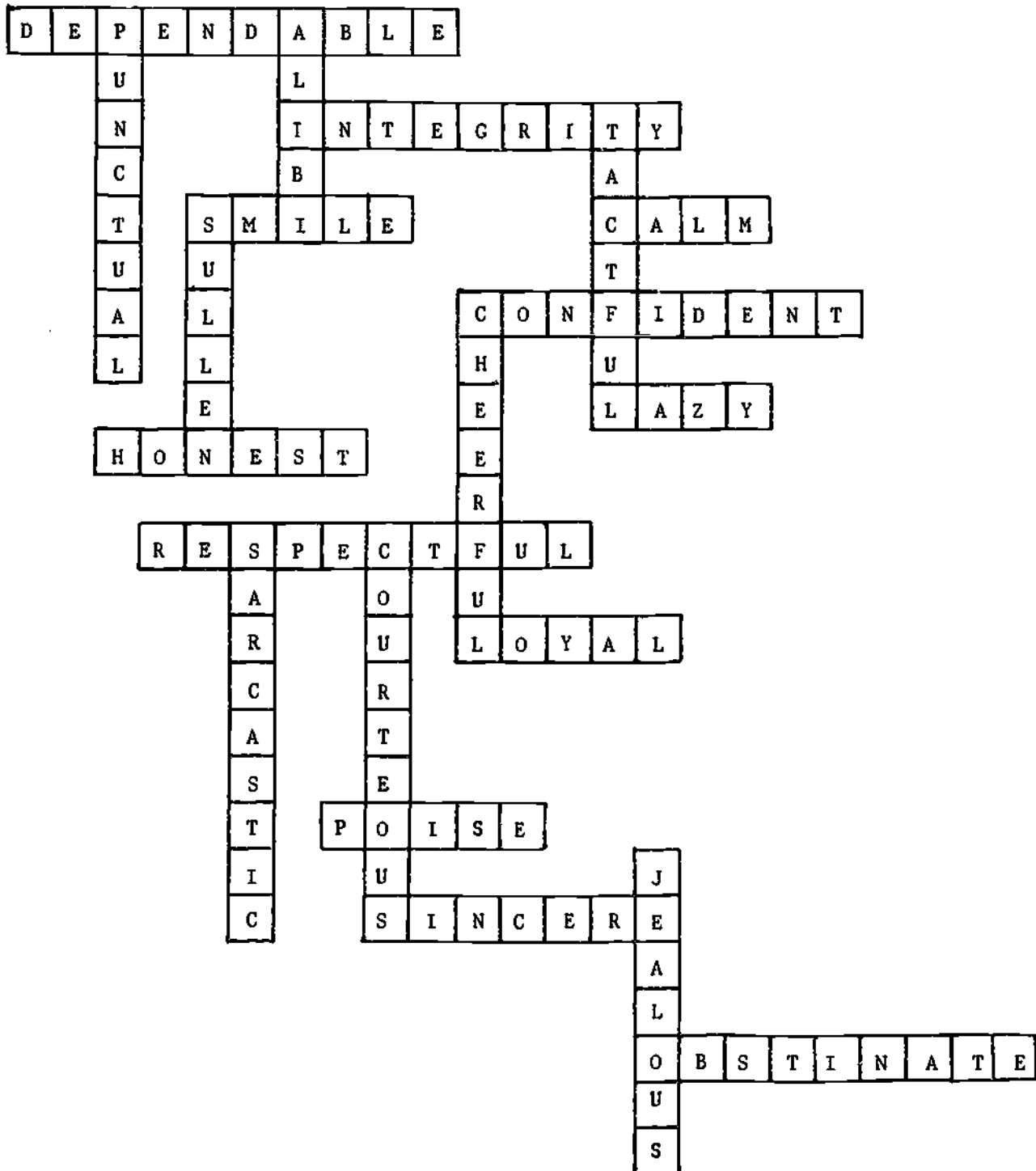
328

615

614

ANSWER KEY - ACTIVITY A: TRAITS WHICH EMPLOYERS SEEK

CROSSWORD PUZZLE





OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(10) After cure is completed, smooth the repaired surface to the same level as the original board using abrasive methods.

(11) If necessary, redrill any holes which existed in the damaged area and clean the repair thoroughly.

2. Rebuilding

a. Damage which extends completely through the board, such as cracks, breaks and holes, must be repaired using rebuilding techniques.

b. Cracks are repaired using the following steps:

61-329

ANSWER KEY - ACTIVITY D: SURE WAYS OF LOSING YOUR JOB

CASE STUDIES (Select from the following)

STRENGTHS

1. Employee No. 1 - (John Thompson)

Neat appearance  
Acceptable work  
Cooperative  
Length of service

Employee No. 2 - (Tom Simmons)

Length of service  
Hard worker  
Dedication to job  
Willing to work overtime

Employee No. 3 - (Sue Jones)

Quality of work  
Length of service  
Efficient worker

Employee No. 4 - (Cindy Little)

Enthusiasm toward work  
Willing to learn and improve

Employee No. 5 - (Betty Brown)

Dependable worker  
Does quality work

Employee No. 6 - (Bob Bentley)

Liked by other employees  
Conscientious on the job

WEAKNESSES

2. Employee No. 1 - (John Thompson)

Tardiness  
Performs only what is asked of him  
Attitude toward peers  
Boastfulness

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

330

(1) Remove all chips and fractured material using abrasive methods.

(2) Bevel and undercut the edges of the removed area to provide NEEDED physical bond strength.

(3) Fasten a smooth surface tightly against one side of the removed area.

(4) Using clamps fasten the board firmly and immovably, keeping any loose pieces in proper alignment and with the uncovered side of the repair area up.

619

618

ANSWER KEY: PRETEST AND POSTTEST

<u>True - False</u>	<u>Matching</u>	<u>Multiple Choice</u>
1. False	D 11	21. D
2. False	M 12	22. A
3. True	A 13	23. C
4. True	F 14	24. A
5. True	H 15	25. D
7. True	B 16	
7. True	E 17	
8. True	L 18	
9. False	J 19	
10. False	C 20	

26. Answers will vary. Check with your instructor.

27. Select from the following: (Model Answers)

- A. Gossiping (lowers productivity and increases employee turnover)
- B. Careless with tools and equipment (Can cost the company a great deal of money)
- C. Dishonesty (Employees must be trusted without constant watching)
- D. Cannot follow directions (Requires too much supervision time)
- E. Poor attitude toward job (Chronic complainers lower employee output)
- F. Lack of common sense (Good employees can reason things out)
- H. Clock watchers (Employers expect full time on the job)
- I. Disloyal to company (Management does not feel obligated to keep employers who "knock" the company)
- J. Loafs on the job (Loafing causes lost production time so the company must charge more for the product in order to make a profit)
- K. Bad temper (Bad tempered employees are difficult to be around)
- L. Late to work continually (One late employee can hold up the work of several others)
- M. Cannot get along with other employees (Causes disharmony and lowered morale)
- N. Disregard safety rules (company loses money because of loss in production and increased workmen's compensation costs.)
- O. Undependable (Every employer wants workers who can be counted on)

28. Answers will vary. Check with your instructor.

### OUTLINE OF INSTRUCTION

- (5) Mix a compound of epoxy and powdered fiber glass, and fill the cutaway area with this compound being extremely careful to leave no voids or air bubbles.
  - (6) Level the surface of the filled-in area being sure that the surface of the fill material is no lower than the original board surface.
  - (7) Cure, smooth, redrill and clean as in the patching method.
- c. Breaks and holes are repaired in the same manner as cracks unless broken pieces are missing or the hole exceeds 1/2 inch in diameter, in which case the following repair steps are used:

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

(1) Using the same technique as with crack repair, prepare the damaged edges.

(2) Using a scrap board of the same type and thickness, cut a piece that duplicates as nearly as possible the missing area. Prepare the edges of this cut piece in the same manner.

(3) Tightly fasten a smooth surface over one side of the surface over one side of the repair area and firmly clamp the board in an immovable position with the uncovered side of the board up.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

333

623

622

OUTLINE OF INSTRUCTION

- (3) Tightly fasten a smooth surface over one side of the repair area and firmly clamp the board in an immovable position with the uncovered side of the board up.
- (4) Position the replacement piece as nearly as possible to duplicate the original board configuration.
- (5) Complete the repair using the same epoxy-fiber glass mixture and repair techniques as in the patching repair method.

C. Tools and materials used in circuit board repair.

INSTRUCTOR ACTIVITY

C. Display Slide YXH L6-S4

STUDENT ACTIVITY

333

OUTLINE OF INSTRUCTION

1. Handtools

a. The following handtools are those normally used in circuit board repair:

(1) X-Acto knife

(2) C clamp

(3) Various dental files and chisels.

(4) Mixing slab

626

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

334

627



OUTLINE OF INSTRUCTION

(5) Spatula

(6) Bristle brush

(7) Vise

2. Power tools

- a. The following power tools are those normally used in circuit board repair.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

- (1) Rotary tool kit
- (2) Abrasive cutting and grinding bit set.
- (3) Drill press
- (4) Variac
- (5) Curing oven, if available.

630

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

336

631

OUTLINE OF INSTRUCTION

3. Materials

a. The following material are those normally used in circuit board repair.

(1) Cleaning solvent

(2) Kimwipes

(3) Epoxy

(4) Fiber glass powder

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

(5) Masking tape

(6) Scrap circuit boards

D. Types of printed circuit run and pad damage. D. Display Slide YXH L6-S7

1. Cracked conductors

- a. Cracks in conductors may be partially or completely through the conductor.

INSTRUCTOR ACTIVITY

1. Display Slide YXH L6-S5

STUDENT ACTIVITY

338

635

634

OUTLINE OF INSTRUCTION

- b. Crack damage which includes nicks and scratches in the conductor. must be repaired if it exceeds one-tenth of the cross sectional area of the conductor.

2. Missing conductors

- a. In this type of damage, pads or conductor runs are completely missing from the board.

- b. In this category conductors are present but physically damaged to a point beyond repair.

3. Delaminated conductors

INSTRUCTOR ACTIVITY

- 2. Display Slide YXH L6-S6.

- 3. Display Slide YXH L6-S6.

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

- a. Delaminated conductors are those which are no longer bonded to the board surface.
- b. The delamination may occur at any portion of the conductor.
- c. Examples of conductors delaminated at the termination and in the middle.

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

340

## E. Printed circuit run and pad repair techniques

## 1. Crack repair

639

638

### OUTLINE OF INSTRUCTION

- a. Cracks in printed circuit conductors are repaired using the following techniques.

(1) One method of repair is to flow solder across the crack, forming a "solder bridge". This is not a high-reliability repair (since the solder in the break will crack easily) and should be used only when no other technique can be used.

(2) Another method of repair is to lap solder the crack. This method is somewhat stronger than a solder bridge, but still is not highly reliable as it is also subject to solder cracking.

### INSTRUCTOR ACTIVITY

(1) NOTE: "Flow Repair"

(2) NOTE: "Lap Repair"

### STUDENT ACTIVITY

341

### OUTLINE OF INSTRUCTION

- (3) A third repair technique is to drill a hole through the board where the crack is (always drill the hole smaller than the width of run), then install and solder an eyelet. This method is highly reliable but will only work when there is no conductor on the other side of the board opposite the break which may be shorted by the eyelet.
- (4) The clinched staple method of crack repair, which this slide shows, is the most reliable and may be used in nearly all cases. Care must be taken when using this technique not to drill the holes through conductors on the opposite side of the board and to use insulated wire if the wire crosses other conductors.

### INSTRUCTOR ACTIVITY

- (3) NOTE: "Eyelet Repair" EYELET installation techniques will be covered later in this lesson.

- (4) Display Slide YXH L6-58.  
NOTE: Stress checking other side of board for components before drilling.

### STUDENT ACTIVITY

342

643

642



OUTLINE OF INSTRUCTION

2. Conductor replacement

a. A conductor which is missing or damaged so badly that it must be replaced. The following procedures are used to repair this type of damage.

- (1) To replace sections of conductors, cut away the badly damaged portion, if present and drill a small hole through the remaining conductor at each end of the break. Do not drill hole through conductors on the opposite side of the board.

INSTRUCTOR ACTIVITY

2. Display Slide YXH L6-S9.

- (1) Display Slide YXH L6-S10.

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

(2) Use a jumper wire to replace missing conductor. Insulated wire must be used to prevent shorts if jumper crosses other conductors.

(3) A completed conductor replacement with the jumper leads clinched and soldered.

(a) This type of repair is merely an elongated version of the clinched staple.

(b) The reliability of the repair may be increased even more by installing an eyelet in the drilled holes.

INSTRUCTOR ACTIVITY

(2) Display Slide YXH L6-S11.

(3) Display Slide YXH L6-S12.  
NOTE: That the replaced section is placed on the opposite side of the board to provide maximum physical strength.

STUDENT ACTIVITY

hhc

647

646

### OUTLINE OF INSTRUCTION

b. A last resort method of replacing conductors known as "haywiring"

(1) If it is not possible to drill through the board because of conductors on the other side, the entire conductor may be removed and a jumper wire soldered directly to straight-through component leads.

(2) Technique is very difficult to use if conductor connects more than two components.

(3) Technique should be used only as a last resort when other replacement techniques cannot be applied since it reduces component mounting strength and must be disassembled to remove components.

### INSTRUCTOR ACTIVITY

b. Display Slide YXH L6-S13  
NOTE: "Haywiring Repair"

(3) Display Slide YXH L6-S14.

### STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

c. Technique for replacing missing pads.

(1) Obtain a replacement pad from a scrap circuit board.

(2) Reinforce the pad by installing an eyelet.

(3) Lap solder the pad to the run.

INSTRUCTOR ACTIVITY

c. Display Slide YXH L6-S15.

STUDENT ACTIVITY

346

651

650

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>(4) For maximum reliability, the conductor edges should be beveled before soldering and the replacement pad epoxied to the board prior to soldering and eyeletting. As an alternate to beveling, a matching spacer pad may be positioned on the board and the replacement pad lap soldered to both it and the conductor run after eyeletting.</p> <p>3: Conductor bonding</p> <p>a. Delaminated conductors resulting from improper repair techniques.</p>	<p>a. Display Slide YXH L6-S16.</p>	






652

653

347

OUTLINE OF INSTRUCTION

b. Proper method of rebonding de-laminated conductors to board surface.

(1) Mix a small amount of epoxy and apply it to the conductor and the conductor path, leaving no uncoated areas.

(2) Clamp conductor firmly against board surface until epoxy has completely cured.

(3) If lifted area is at end of conductor, it may be eyeletted immediately after epoxy is applied.

654

INSTRUCTOR ACTIVITY

b. Display Slide YXH L6-S17.

STUDENT ACTIVITY

848

655

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

F. Tools used in printed circuit run and pad repair

1. Handtools

a. X-Acto knife

b. C clamp

c. Tweezers

d. Circuit board holder

656

657

349

OUTLINE OF INSTRUCTION

e. Vise

f. Mixing slab

g. Spatula

h. Bristle brush

2. Power tools

a. Rotary tool kit

658

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

350

659

2-4-36



OUTLINE OF INSTRUCTION

b. Abrasive cutting and grinding bit set.

c. Drill press

d. Variac

e. Curing oven, if available

f. Soldering iron

3. Materials

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

a. Wire

b. Solvent

c. Kimwipes

d. Epoxy

e. Flux

f. Solder

662

g. Scrap circuit boards

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

352

663

OUTLINE OF INSTRUCTION

6. Techniques for replacing damaged printed circuit eyelets.

1. Selecting

a. The eyelet must be approximately 1/32 inch longer than the board thickness.

b. The eyelet hole must be just large enough to allow the lead to pass through it freely without binding.

INSTRUCTOR ACTIVITY

1. Display Slide YXH L6-18.

STUDENT ACTIVITY

664

665 353

# SAFETY

## Learning Activity Package



**BEST COPY AVAILABLE**

### A Guide for Industrial Cooperative Training Programs



U.S. DEPARTMENT OF HEALTH  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

TRADE AND INDUSTRIAL EDUCATION SERVICE

Division of Program Services  
Vocational and Adult Education  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216  
May, 1980

LAP 6

OUTLINE OF INSTRUCTION

2. Drilling

a. A drill bit must be selected which will make a hole just large enough for the selected eyelet to fit in snugly.

b. Do not use excessive force when drilling the hole as it may damage the board.

c. The hole must not be drilled at an angle.

666

INSTRUCTOR ACTIVITY

2. NOTE: Drill press should be used with CARE.

STUDENT ACTIVITY

354

667

SAFETY

Learning Activities Package



For use with  
Industrial Cooperative Training Programs

TRADE AND INDUSTRIAL EDUCATION SERVICE  
Division of Program Service  
Vocational and Adult Education

S. John Davis  
Superintendent of Public Instruction  
Department of Education  
Commonwealth of Virginia  
Richmond, Virginia 23216

May 1980

NOV 17 1980

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- d. When replacing an eyelet where one previously existed, the drill bit should be the same size as the original hole and the eyelet should be picked to fit the hole size.
- e. When drilling to install an eyelet where none previously existed, be sure to examine both sides of the board and determine that no conductor damage or shorting will be caused by the eyelet installation.

3. Setting

- a. The first step in setting an eyelet is to brace the preformed head of the eyelet against a flat, solid surface such as a jeweler anvil.

668

669

355

## INTRODUCTION

Accidents result from the mistakes made by workers and the misuse of materials and equipment. They cause a loss to the employer and employee alike. In most cases, a little bit of forethought, a little care, a little more alertness might mean the difference between disability or death on one hand, or an accident-free life on the other.

Just one foolish action,--perhaps your mind wandered, or maybe you took a foolish chance,--can cause much pain and suffering. Think about what it must be like to spend the rest of your life in a wheelchair, to lose the use of a hand or arm, or to be blind. Is it really worth taking foolish risks?

The misery, pain and suffering caused by needless accidents is serious enough but the loss of earning power must also be considered. You may be eligible for Workmen's Compensation or Welfare to tide you over, but you could not enjoy many luxuries if you were to depend completely on such income.

It would be well to consider also how your own feelings might change as a result of a long-term disability accident. Consider how it must feel to see others go to work each day, to be able to furnish a nice home, and buy nice things for their families--while you must have someone else to take care of you.

Nearly all accidents can be avoided. The most important method is simply to follow safety regulations and use common sense on the job, on the highway and at home. Unfortunately, we tend to think that accidents always happen to the other person--well, that other person could be you! Safety costs you nothing and saves you a lot.



### OUTLINE OF INSTRUCTION

b. The unformed end of the eyelet is then flared to an approximate 45-degree angle by punching the end ONE time with an adjustable, spring-loaded, automatic center punch.

c. The punch is adjusted for proper striking force by setting a practice eyelet on a scrap circuit board.

d. The flared end is set flat by tapping a flat pin punch GENTLY against the flared end with a soft-faced hammer. A single tap should be sufficient to properly set the eyelet.

### 4. Soldering

670

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

356

671

## PRETEST

Give a response for each of the following. Be brief and to the point.

1. Explain why each of the following characteristics could help a person to prevent accidents.

A. Calmness \_\_\_\_\_  
B. Alertness \_\_\_\_\_  
C. Remembers instructions \_\_\_\_\_  
D. Serious about work \_\_\_\_\_

2. Explain why each of the following characteristics could lead to accidents on the job.

A. "Hot headed" \_\_\_\_\_  
B. "Lazy" \_\_\_\_\_  
C. "Forgetful" \_\_\_\_\_  
D. "Complainer" \_\_\_\_\_

3. Give an example of each of the following tool hazards.

A. Using the wrong tool for a job.

\_\_\_\_\_

B. Using a tool incorrectly.

\_\_\_\_\_

C. Using an unsafe tool.

\_\_\_\_\_

D. Storing tools incorrectly.

\_\_\_\_\_

### OUTLINE OF INSTRUCTION

- a. After setting, the eyelet should be soldered to the circuit conductors for highest reliability.
- b. If a lead or wire is to be soldered through the eyelet, the lead and eyelet should both be soldered in a single operation.

H. Tools used to install printed circuit eyelets.

#### 1. Handtools

- a. Tweezers

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

1. Display Slide YXH L6-S19.

Pretest (Continued)

Match the class of fire in the right hand column with type of fuel in the left-hand column. You may use the letters more than once.

- |                              |         |
|------------------------------|---------|
| _____ 16. paper              | Class A |
| _____ 17. powdered aluminum  | Class B |
| _____ 18. rags               | Class C |
| _____ 19. motor wiring       | Class D |
| _____ 20. kerosene           |         |
| _____ 21. paint              |         |
| _____ 22. wood               |         |
| _____ 23. transformer        |         |
| _____ 24. powdered magnesium |         |
| _____ 25. gasoline           |         |

Answer the following questions in the blanks provided.

26. How should broken glass be discarded?

\_\_\_\_\_

27. Why would it be unsafe to leave a tool on the top of a step ladder?

\_\_\_\_\_

28. What is a problem with carrying large boxes up or down steps?

\_\_\_\_\_

29. What are three things to look for in checking the safety of a ladder?

\_\_\_\_\_

30. What is a rule to follow when determining how far to reach out when working on a ladder?

\_\_\_\_\_

31. How is it determined if a ladder is set at a safe angle?

\_\_\_\_\_

OUTLINE OF INSTRUCTION

b. Automatic center punch

c. Pin punch

d. Jeweler anvil

e. Soft-faced hammer

2. Power tools

a. Drill press

674

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

358

675

## LEARNING ACTIVITY A

### YOUR SAFETY ATTITUDE

Objective: You will be able to explain four characteristics which help to prevent accidents, and four characteristics which could lead to accidents.

What are some things which you can do personally to act in a safe manner? First of all you can develop a safety attitude. In other words, you need to be aware of dangers in handling tools and materials, working with electricity, doing improper lifting,

and other hazards. A safety attitude is really a "sixth sense". Something in your mind says to you: "Be careful, observe the dangers before you act". A good safety attitude will cause you to be cautious and think through your actions beforehand.

Different workers show different levels of safety attitudes. Having

a good safety attitude results in being a safe worker. The opposite is also true. It is really very simple--you probably will be free of accidents most of your life if you develop the right attitude toward safety.

Now let's contrast the good safety attitude with the poor safety attitude. The safety-minded worker follows the rules, is calm, alert, remembers things which were told, and is serious about doing a good job. The accident prone worker, on the other hand, shows such traits as being a show-off, "hot-headed", lazy, careless, disobedient, forgetful, bored with work, inattentive or a "complainer". So you see, your general attitude toward the job, has a lot to do with your feelings about safety.



<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
b. Rotary tool kit		
c. Abrasive grinding and cutting bit set.		
d. Variac		
e. Soldering iron		
3. Materials		
a. Eyelets		

676

677 359 b5c

Your Safety Attitude (Continued)

Answer the following questions:

1. What is a safety attitude? \_\_\_\_\_  
\_\_\_\_\_
2. What do we mean by a "sixth sense" toward safety? \_\_\_\_\_  
\_\_\_\_\_
3. How does the safety conscious person act on the job? \_\_\_\_\_  
\_\_\_\_\_
4. What are nine characteristics of the accident prone worker? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Could you describe five of your personality traits? How do you think these traits will affect your safety performance?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



OUTLINE OF INSTRUCTION

b. Solvent

c. Kimwipes

d. Flux

e. Solder

- I. Evaluating damaged printed circuit boards to determine extent of repair necessary and repair techniques to be used.

1. Determining board construction.

678

INSTRUCTOR ACTIVITY

1. Display Slide YXH L6-S20.

2-4-46

STUDENT ACTIVITY

360

679

## Hazards in Using Tools (Continued)

slip and cause injury to your hand. Always remember to use only the tools which are meant for the particular job you are doing.

### Use the Tool Correctly

Using the right tool for the job is important but it is equally important to use the tool correctly. Note that the worker in Figure 2 is holding the material with one hand while he turns the screw with the other



Fig. 2

hand. Such practice is sure to cause injury if the screwdriver slips.

A worker who pushes a wrench in the direction of a protruding part is creating a hazard. Your supervisor will show you how to use tools properly.

It is your responsibility to follow the directions completely.

### Be Sure the Tool is in a Safe Condition

A third thing to remember when using tools is to be sure that the tool is in a safe condition. Note in Figure 3 the "mushroom" head on the unsafe

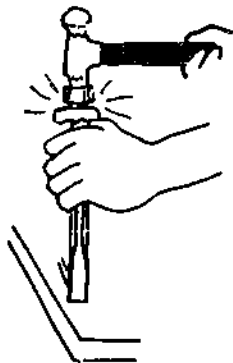


Fig. 3

chisel. The worker who chooses to use the mushroom head tool would be taking a chance because metal pieces from the head could break off and cause injury. Never use tools which have cracked handles or tools which are not fastened properly to the handle. Always check

each tool to be sure that it is in proper condition before you use it.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>a. The following major characteristics must be properly evaluated to determine the overall construction of a circuit board:</p> <p>(1) Type of circuit baseboard material.</p> <p>(2) Circuit conductor style.</p> <p>(3) Component types.</p> <p>(4) Component mounting style.</p> <p>(5) Type of lead termination.</p>		

Hazards in Using Tools (continued)

Part I

To the right there is a list of the four main tool hazards discussed. Match these hazards with the accidents listed on the left. You may use the letters more than once.

- |  |  |
|--|--|
| _____ 1. A worker moves a cabinet and is injured by a wrench falling from it.                        | A. The tool is not right for the job.        |
| _____ 2. A worker is cut when pulling a chisel out of a drawer.                                      | B. The tool is not being used correctly.     |
| _____ 3. An injury occurs from opening a paint can with a chisel.                                    | C. The tool is not in a safe condition.      |
| _____ 4. An old and worn wrench slips on a nut and the worker's knuckles are skinned.                | D. The tool is not put away in a safe place. |
| _____ 5. A worker is cut with sheet metal because the tin snips are being used incorrectly.          |  |
| _____ 6. A worker's hand is cut pushing the knife toward instead of away from the body.              |  |
| _____ 7. A worker is struck on the head by a hammer head which flies off from the handle.            |  |
| _____ 8. An injury occurs by using a screwdriver instead of a gear puller to remove a "frozen" part. |  |
| _____ 9. A worker had a bad fall after stumbling on a tool left on the stairs.                       |  |
| _____ 10. An injury occurs by using a mushroom head chisel to cut through a bolt.                    |  |



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

362

(6) Type of interfacial connection

(7) Solder-joint type

(8) Type of conformal coating

b. Board style in use extensively today:

b. Display Slide YXH L6-S21 and point out the characteristics.

(1) The baseboard material is type G-10 epoxy-glass which consists of thin layers of fiber glass laminated together with epoxy.

682

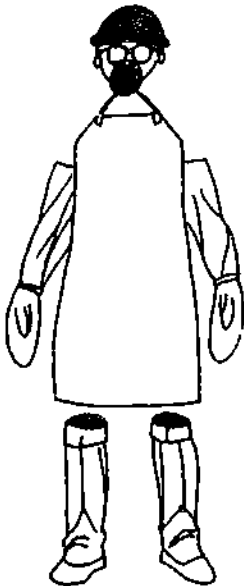
683

## LEARNING ACTIVITY C

### PERSONAL PROTECTIVE EQUIPMENT

Objective: You will be able to demonstrate a knowledge of twelve basic points of equipment usage.

Personal Protective Equipment refers to such safety items as respirators, safety goggles, face shields and safety shoes. Many jobs in industry involve hazards which require you to take protective action. It becomes a personal matter for each employee to know how to use personal protective equipment.



You may have the idea that the company should be doing all of the safety planning for you. It is important to realize that you also have an obligation to protect yourself on the job. Studies show that over 12 percent of major and sub-major injuries occur because of employees' failure to wear personal protective equipment.

Remember when you are working in a "hazardous area" or with hazardous materials, the wearing of personal protective equipment will not eliminate the hazard but it will protect you personally. Let's take a look at some of the different types of personal protective equipment.

Protection for Eyes and Face. In American industry there are over 1,000 serious eye injuries every day. Every year about 400 persons lose the sight of both eyes and over 3,000 persons lose the sight of one eye. Have you ever thought about what it might be like to be blind? Persons who were

OUTLINE OF INSTRUCTION

(2) This is currently the most widely used baseboard material. Note the drab green color and weave of the fiber glass.

(3) Other assembly characteristics are double-sided circuits, gold-plated conductors and flush-mounted discrete components.

c. Variety of modules used by IBM:

(1) Tan modules are single-sided circuits with flush-mounted discrete components mounted on a paper phenolic baseboard.

INSTRUCTOR ACTIVITY

c. Display Slide YXH L6-522.

STUDENT ACTIVITY

684

685

363

## Personal Protective Equipment (Continued)

Such glasses should always have side shields to provide complete protection on all sides. Visitors who are touring a plant will generally be asked to wear safety glasses.

Face shields are meant to protect the entire face rather than the eyes only. They come in many shapes and styles. Some types protect the chin and ears, while others protect only the front of the face. Face shields allow open vision from all directions. Face helmets are made of a strong solid material, with a safety glass covered opening to permit vision. Helmets are used for electric welding and other jobs where heavy face protection is needed.

Safety goggles, also known as eye-cup goggles, completely protect the eyes by resting on the face bones around the eyes. Because they fit tightly around the eyes, they tend to fog up. Therefore, ventilation openings are provided to allow circulation of air. When dust or liquids are present, the ventilation openings are screened or baffled. Welders will require goggles with tinted glass and ventilation openings baffled against the light. Goggles are worn for acetylene welding, chemical handling, chipping, machining and handling molten metals.

In each of the listed categories, there are many types of eye protection. Always check with your supervisor to be sure that you are using the right kind of eye protection for the job. An exclusive club, the Wise Owl Club, accepts as members only those persons who saved the sight of one or both



Emblem of the Wise Owl Club



### OUTLINE OF INSTRUCTION

- (2) Phenolic baseboards are either pressed laminated of resin-saturated linen (XXXL) or a pressed laminate of resin-saturated paper (XXXP).
- (3) The two very small modules demonstrate "Cordwood" mounting style.
- (4) Dark colored modules are from the 360 computer. They have multilayer conductors with plated-through holes.
- (5) Silver submodules on boards are multilead, RTV-potted, hermetically-sealed, ceramic substrate printed circuits.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

364

687

686

## Personal Protective Equipment (Continued)

### Type of Hand Protection and Suggested Uses

Handling acids



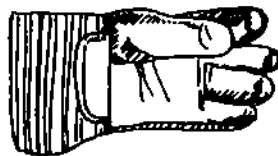
Neoprene glove

Handling sharp  
objects



Mesh glove

Handling wood  
materials



Leather glove

Handling hot  
castings



Abestos mit

Gloves are worn in order to protect the hands when handling materials. They should not be worn around revolving machinery. Note the different types of gloves and their uses in the above illustration.

Gauntlets are gloves which extend over the wrist and/or lower arm. They provide greater protection than gloves. Some workers wear hand pads or guards to protect the hands against sharp edges. Hand pads cover the palms and fingers but do not protect the back of the hand.

Many injuries occur from dropping heavy objects on the foot or toes. Safety shoes have been developed which have built-in steel toes.

### OUTLINE OF INSTRUCTION

d. Heat-controlled crystal oven with an insulating cover.

e. Typical submodules

(1) Note the various lead configurations, dual-in-line and circular-in-line.

(2) Black modules are unused shells which are assembled by soldering or welding components and then potting.

f. Submodules mounted on a component board.

### INSTRUCTOR ACTIVITY

d. Display Slide YXH L6-S23.

e. Display Slide YXH L6-S24.

f. Display Slide YXH L6-S25.

### STUDENT ACTIVITY

## Personal Protective Equipment (Continued)

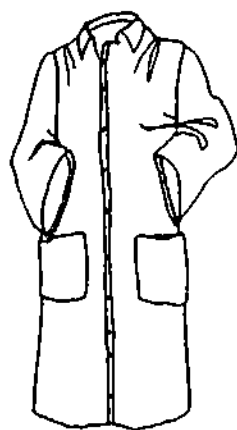
Supplied air respirators do not remove harmful materials from the air. This type of respirator provides clean air to the wearer from a special air tank.



Supplied Air Respirator

Other Types of Protective Equipment. Proper dress is important for the safety of workers. Use of shop coats, aprons and coveralls will aid in protecting the worker from chemicals and hot substances. Such dress also protects from grease and dirt.

Coats with sleeves should not be worn around moving machinery. Aprons may be bib-type or waist-type. The bib-type apron covers the chest down to the knees or ankles. Coveralls cover the whole body except for head, hands and feet. They are usually made of a very rugged material and can stand wear over long periods of time.



Shop Coat



Apron



Coverall

### OUTLINE OF INSTRUCTION

(1) Components are vertically mounted with one end termination going to a multi-connection solder cup stand off.

(2) Eyelets are used for interfacial connections.

(3) Baseboard is epoxy-glass. The light tan color indicates a flame retardant (FR) variety.

g. Submodules, vertically mounted on a "mother board" which has double-sided circuitry.

### INSTRUCTOR ACTIVITY

g. Display Slide YXH L6-S26.

### STUDENT ACTIVITY

366

690

691

Personal Protective Equipment (Continued)

Part II.

Select the best answer to the following questions. Place the letter of the statement in the blank at the left.

- \_\_\_\_ 1. Which type of eye protection are visitors usually issued when touring a plant?
- A. safety glasses
  - B. face shields
  - C. safety goggles
  - D. ear protectors
- \_\_\_\_ 2. In what way do safety goggles differ from safety glasses?
- A. they cover the entire face
  - B. the glass is stronger
  - C. they are ventilated better
  - D. they fit tightly around the eye
- \_\_\_\_ 3. The Wise Owl Club serves what purpose?
- A. a group of people who are interested in eye safety
  - B. a club whose members were saved from blindness in one or both eyes by using eye protection
  - C. a club interested in promoting general safety in industry
  - D. a student group which promotes safety contests
- \_\_\_\_ 4. Which group of workers would most likely be wearing hard hats?
- A. assembly line workers
  - B. construction workers
  - C. office workers
  - C. machinists

### OUTLINE OF INSTRUCTION

h. Example of gold amalgamation of a double-sided board with gold-plated conductors.

(1) Frosty appearance of solder is gold amalgamation.

(2) Gold should be removed before soldering for highest reliability connections.

(3) Conductive high carbon content ink was accidentally used to silk screen identification marking onto this board. The result was a series of malfunctioning boards.

692

### INSTRUCTOR ACTIVITY

h. Display Slide YXH L6-S27.

### STUDENT ACTIVITY

693

367

Personal Protective Equipment (Continued)

- \_\_\_ 10. What is the purpose of a filter?
- A. provides clean air from a special tank
  - B. traps spray, fumes, dust or mist
  - C. protects face and eyes from glare
  - D. protects ears from noise





OUTLINE OF INSTRUCTION

i. Transistor mounted through the board in drilled holes. The module was conformal coated with epoxy after assembly.

j. Hybrid using vacuum tubes in combination with transistorized submodules built into the special tube bases.

(1) Board material is XXXP phenolic.

(2) The hand set eyelets and tablets caused the board to crack from tight swedging and board expansion due to heat generated by vacuum tubes.

694

INSTRUCTOR ACTIVITY

i. Display Slide YXH L6-528.

j. Display Slide YXH L6-529.

STUDENT ACTIVITY

368

695

## Use of Fire Extinguishers (Continued)

The second ingredient for a fire is air. Really it is the oxygen in the air that is necessary to keep the fire going. All fires need air to exist. When the metal cap on a cigarette lighter is snapped shut, the flame goes out because of lack of air. If you place your hand over the air intake of a carburetor, the engine will stop because of lack of air. In a real fire situation it is

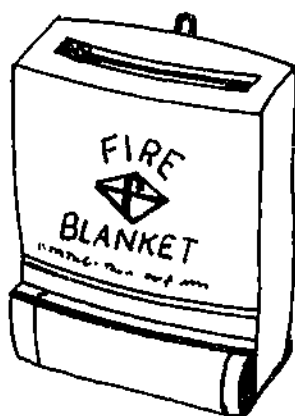
often possible to smother out the fire with a blanket or coat. By doing this you are cutting off the supply of air to the fire.

1. **FUEL**

2. **AIR**

3. **HEAT**

### The Ingredients of Fire



A fire blanket cuts off the air supply.

The third ingredient needed for fire is heat. Fuels will not burn unless there is heat. Another name for heat is source of ignition. Some sources might be sparks from a welding unit, an electrical short circuit, overheated bearing or a propane torch flame. If a fire has already started, the heat given off produces good conditions for it to spread rapidly.

### OUTLINE OF INSTRUCTION

k. Capacitors mounted between turret terminals

(1) Lead material forming capacitor plates is also brought through the glass end seal, since it has the same temperature expansion characteristics as the glass and will not cause the seal to break.

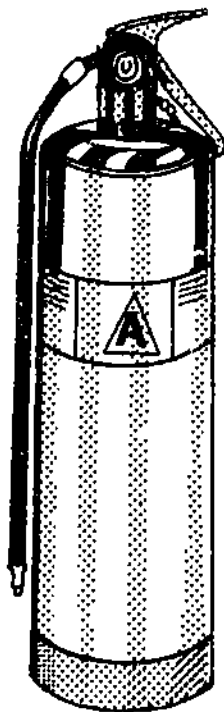
(2) The special lead material is not solderable, thus a solderable lead must be welded to it so that the component may be soldered into the circuit.

### INSTRUCTOR ACTIVITY

k. Display Slide YXH L6-S30.  
NOTE: The unusual style of welds on the capacitor leads.

### STUDENT ACTIVITY

## Use of Fire Extinguishers (Continued)



A Class A Fire  
Pressurized Water Extinguisher



A Class B and C Fires  
Dry Chemical Extinguishers

Class C fires occur in or near live electrical equipment. A Class C fire could occur in lighting circuits, appliances, motors, transformers and other electrical equipment. Whenever electricity is present and a fire occurs, the material used to extinguish it must not be conductive, or carry an electrical current. Extinguishers which contain water should never be used on Class C fires. Two types of materials are used in Class C fire extinguishers. These are dry chemicals (also used for Class B fires) and liquified gas. Both of these materials will smother the fire, removing the air from the fire triangle.

Class D fires occur in certain powdered metals when heated to a very high temperature. These fires are not nearly as common as Class A, B, or C fires but can still be very difficult to extinguish. Examples of powdered metals

OUTLINE OF INSTRUCTION

(3) Normal welding style is a butt weld versus the lap weld shown.

(4) The baseboard material in this case is linen phenolic (XXXL).

1. Method of manufacturing printed circuit baseboard laminates,

(1) Epoxy-glass substrate layers laminated together with an outer layer of copper on one or both sides to form single or double-sided circuit boards.

INSTRUCTOR ACTIVITY

1. Display Slide YXH L6-531.

STUDENT ACTIVITY

370

698

698

## Use of Fire Extinguishers (Continued)

### Part I

Below are several types of fires which could happen sometime on your job. Circle the class of fire (A, B, C, or D), and check the type or types of fire extinguishers to use. The first one has been done as an example.

Material Burning	Type of Fire	Type of Fire Extinguisher to Use
Powdered metal burning	A B C <u>D</u>	<input type="checkbox"/> Pressurized water <input type="checkbox"/> Foam <input type="checkbox"/> Liquified gas <input type="checkbox"/> Dry chemical <input checked="" type="checkbox"/> Special dry powder
Paper - wood burning	A B C D	<input type="checkbox"/> Pressurized water <input type="checkbox"/> Foam <input type="checkbox"/> Liquified gas <input type="checkbox"/> Dry chemical <input type="checkbox"/> Special dry powder
Gasoline burning	A B C D	<input type="checkbox"/> Pressurized water <input type="checkbox"/> Foam <input type="checkbox"/> Liquified gas <input type="checkbox"/> Dry chemical <input type="checkbox"/> Special dry powder
Electrical fire	A B C D	<input type="checkbox"/> Pressurized water <input type="checkbox"/> Foam <input type="checkbox"/> Liquified gas <input type="checkbox"/> Dry chemical <input type="checkbox"/> Special dry powder

OUTLINE OF INSTRUCTION

(2) The lamination bond is formed under high heat and pressure during the epoxy cure cycle.

m. The four most common board thicknesses: 1/32-, 1/16-, 1/8- inch.

(1) The thickness of board used is determined by the bulk and weight of the components to be used.

(2) The most commonly used thickness in todays circuitry is the 1/16-inch board.

INSTRUCTOR ACTIVITY

m. Display Slide YXH L6-S32.

STUDENT ACTIVITY

700

701

371

## Use of Fire Extinguishers (Continued)

### Part III

Give a statement for each of the following. Be brief and to the point.

1. Explain how you would handle the situation if you noticed a small fire and there were several other workers in the area.

---

---

---

2. Give an example of each of the three ingredients of the fire triangle.

---

---

---

3. Explain why it would not be wise to try to extinguish a Class B fire with a Class A extinguisher.

---

---

---

4. What type of materials are used to put out Class C fires?

---

---

---

5. Why are some fire extinguishers classified as A B C?

---

---

---



OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
<p>n. Examples of standard conductor thicknesses used on printed circuit boards. There are four commonly used thicknesses.</p> <p>(1) 1 ounce - 0.0014 inch or 1.4 mils.</p> <p>(2) 2 ounces - 0.0028 inch or 2.8 mils.</p> <p>(3) 3 ounces - 0.0042 inch or 4.2 mils.</p> <p>(4) 4 ounces - 0.0056 inch or 5.6 mils.</p>	<p>n. Display Slide YXH L6-533.</p>	<p>372</p> <p>703</p>

702

## Preferred Safety Practices (Continued)

### Prevent Falls

1. Pick up scrap materials which could cause falls.
2. Wear shoes which are in good condition and give good support. Be sure that shoes have the right sole and heel material for the kind of floor surface on which you work.
3. "Unfunny" jokes can cause injuries. Do not ever startle someone with a loud noise or purposely trip someone.
4. When walking on stairs, do not carry something so big that you cannot see where you are going.
5. Stand on a ladder rather than boxes or chairs. Do not climb on shelves.
6. If you work on a scaffold, check it out thoroughly for any defective planks.
7. Check that guard rails and toe boards are in good shape.
8. On rolling scaffolds be sure that casters are locked and wheels blocked before climbing up.



OUTLINE OF INSTRUCTION

- (5) The weight designation is obtained from weighing 1 ft<sup>2</sup> of the copper material prior to any plating.

- o. Step-by-step process of photo-etching conductor designs on a circuit board.

- (1) Mask the photosensitive etchant resist film and expose the conductor areas.

- (2) Develop the photosensitive film. The exposed area will become resistant to a solvent wash solution.

INSTRUCTOR ACTIVITY

- o. Display Slide YXH L6-634.

STUDENT ACTIVITY

704.

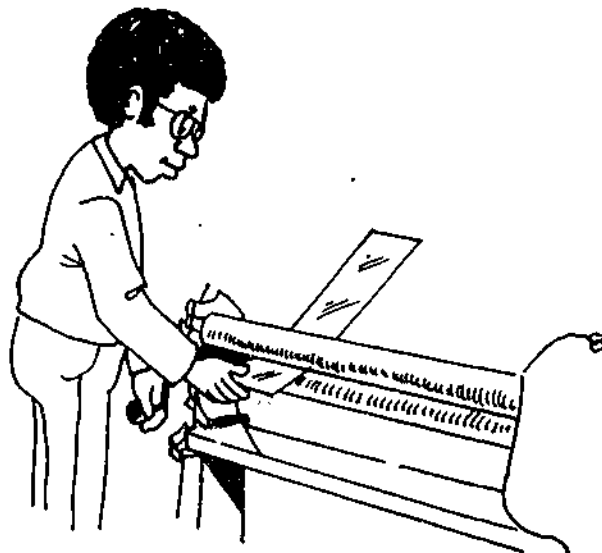
705

373

## Preferred Safety Practices (Continued)

### Guarding Your Hands

1. Check that machine guards are in place and operating correctly.
2. Never operate a machine without the guard in place. Guards are there to save your hands from injury.
3. Be sure to shut off a machine in order to oil, grease, clean or adjust it.
4. Keep your hands away from moving parts such as gears, rollers, belts and cutters.
5. Keep your hands clear when hoists and slings are being tightened.
6. Wear protective gloves when handling wire cable.
7. Use a mesh glove when cutting or slicing.
8. Always cut away from your body.
9. Never sweep away scraps or shavings with your hands. Always use a brush.
10. Do not wear rings, watchbands, bracelets, or necklaces around machinery.
11. Be alert for pinch points such as between a door frame and a crate.
12. Wear gloves in work situations where hand protection is necessary.
13. Use the right tool; make sure it is in good condition.



OUTLINE OF INSTRUCTION

(3) Place in solvent bath which will remove the unexposed resist films.

(4) Place the board in an etching solution which will remove all copper not covered by the resist film.

(5) Solvent rinse to remove all etchant solution and the resist material which remains on the conductor pattern to complete the board.

p. Step-by-step process of silk screen etching conductor designs on a circuit board.

706

INSTRUCTOR ACTIVITY:

p. Display Slide YXH L6-535.

STUDENT ACTIVITY

394

707

## Preferred Safety Practices (Continued)

### Fire Safety

1. Know where fire fighting equipment is and how to use it.
2. Know your company rules about fire.
3. Store flammable liquids in approved metal safety containers.
4. Do not use highly flammable liquids for cleaning parts.
5. If clothing should catch on fire, smother flames by wrapping in a blanket, a coat, or rolling on the ground.
6. Know the proper procedure for evacuating the building in case of fire.
7. Never block fire doors.
8. Put oily rags in self-closing metal containers.
9. Know where gas cut-off valves are.
10. Do not allow an oil accumulation on the floor.
11. Keep oil and grease accumulations away from motors.
12. Do not smoke in the shop.
13. Wear non-flammable clothing.



OUTLINE OF INSTRUCTION

(1) Apply an etchant resist film to the conductor pattern areas through a silk screen mask.

(2) Place the board in an etching solution which will remove all copper not covered by the screened on film.

(3) Wash the etchant solution from the completed board.

q. Circuit board with large ground plane which also serves as a heat sink.

INSTRUCTOR ACTIVITY

q. Display Slide YXH L6-536.

STUDENT ACTIVITY

## Preferred Safety Practices (Continued)

### First Aid

1. Know where first aid kit is located.
2. If your place of employment has emergency medical services, contact office for company policies.
3. Check that first aid kit is stocked with the required supplies.
4. Report all injuries, minor or otherwise.
5. If caustic chemicals are used, check the location of an eye fountain.
6. Take a company sponsored or Red Cross first aid course if available in your community.





OUTLINE OF INSTRUCTION

r. A closeup showing solder joints to ground plane.

(1) Etched slots in ground plane are for weight reduction and stress relief.

(2) They also serve to prevent heat blistering under the copper during soldering.

s. Reverse side of module which has defective solder joints.

(1) Not the pinholes in some of the solder.

710

INSTRUCTOR ACTIVITY

r. Display Slide YXH L6-S37.

s. Display Slide YXH L6-S38.

STUDENT ACTIVITY

376

711

Preferred Safety Practices (Continued)

T F 12. You should always hold onto the rungs when you climb a ladder.

---

T F 13. If it is possible to do a job quicker without a guard, it is alright to remove the guard.

---

T F 14. Gloves should be worn when hoists and slings are being tightened.

---

T F 15. Wire mesh gloves are used for handling hot materials.

---

T F 16. When using a knife, draw it toward your body.

---

T F 17. Rings and jewelry are a hazard around moving machinery.

---

T F 18. Long hair should be protected around revolving machinery.

---

T F 19. Gasoline is recommended to clean grease from metal parts.

---

T F 20. If clothing should catch on fire, the best method for putting it out is with a Class B extinguisher.

---

T F 21. Caustic chemicals are washed out of the eye at an eye fountain.

---

T F 22. Electrical boxes require covers.

---

T F 23. An aluminum ladder is recommended when working with electricity.

---

T F 24. Rubber mats are advisable when making electrical repairs.

---

T F 25. It is a recommended practice to pull on the cord when removing the plug from the outlet.

---

OUTLINE OF INSTRUCTION

- (2) Pinholes which are the result of incomplete solder flow are caused by out-gassing of wet flux in holes or holes too large for component leads.

t. Typical solder connections

- (1) Left - full clinched lead termination.

- (2) Right - straight-through lead termination.

u. Various types of solderable terminals:

712

INSTRUCTOR ACTIVITY

t. Display Slide YXH L6-S39.

u. Display Slide YXH L6-S40.

STUDENT ACTIVITY

713

377

## Preferred Safety Practices (Continued)

### Machine Safety

---

---

---

---

---

### Fire Safety

---

---

---

---

---

### Electrical Safety

---

---

---

---

---

## Part III

Use the form which follows to do a shop safety survey of your place of employment. Ask permission from your supervisor before beginning the survey. If the survey form does not apply to your employment situation, plan a revised form which is appropriate. When you have completed the survey, discuss it with your instructor.

OUTLINE OF INSTRUCTION

(1) Turret style

(2) Hook style

(3) Eyelet or tab style

(4) Bifurcated style

(5) Solder cup style (these are the same as solder cup connector pins)

v. Shown are typical terminals mounted on liner phenolic (XXXL) boards.

714

INSTRUCTOR ACTIVITY

v. Display Slide YXH L6-S41.

STUDENT ACTIVITY

378

715

[illegible]

- [illegible]

[illegible]

- [illegible]

[illegible]

- [illegible]

[illegible]

- [illegible]

OUTLINE OF INSTRUCTION

(1) Turret terminals

(2) Bifurcated terminals

(3) Castellated terminals

w. Various sized terminals which are used to mount different sized components.

(1) Large terminals with large components and small components on small terminals.

INSTRUCTOR ACTIVITY

w. Display Slide YXH L6-S42.

STUDENT ACTIVITY

716

717

379

## POSTTEST

Give a response for each of the following. Be brief and to the point.

1. Explain why each of the following characteristics could help a person to prevent accidents.

A. Calmness \_\_\_\_\_  
B. Alertness \_\_\_\_\_  
C. Remembers instructions \_\_\_\_\_  
D. Serious about work \_\_\_\_\_

2. Explain why each of the following characteristics could lead to accidents on the job.

A. "Hot headed" \_\_\_\_\_  
B. "Lazy" \_\_\_\_\_  
C. "Forgetful" \_\_\_\_\_  
D. "Complainer" \_\_\_\_\_

3. Give an example of each of the following tool hazards.

A. Using the wrong tool for a job.

\_\_\_\_\_

B. Using a tool incorrectly.

\_\_\_\_\_

C. Using an unsafe tool.

\_\_\_\_\_

D. Storing tools incorrectly.

\_\_\_\_\_



### OUTLINE OF INSTRUCTION

- (2) Note the leads formed with slack for stress relief at component to lead junctions.
- x. Board using hollow standoffs for multilead connections of vertically mounted components.
- y. Typical circuit board edge connector with mating receptacle.
- z. A beveled edge on an edge connector, where plug-in takes place. The bevel is to reduce abrasion on receptacle and prevent peel-back of pin on board.

### INSTRUCTOR ACTIVITY

- x. Display Slide YXH L6-S43.
- y. Display Slide YXH L6-S44.
- z. Display Slide YXH L6-S45.

### STUDENT ACTIVITY

380

718

719

Posttest (Continued)

Match the class of fire in the right hand column with type of fuel in the left-hand column. You may use the letters more than once.

- |                              |         |
|------------------------------|---------|
| _____ 16. paper              | Class A |
| _____ 17. powdered aluminum  | Class B |
| _____ 18. rags               | Class C |
| _____ 19. motor wiring       | Class D |
| _____ 20. kerosene           |         |
| _____ 21. paint              |         |
| _____ 22. wood               |         |
| _____ 23. transformer        |         |
| _____ 24. powdered magnesium |         |
| _____ 25. gasoline           |         |

Answer the following questions in the blanks provided.

26. How should broken glass be discarded?

\_\_\_\_\_

27. Why would it be unsafe to leave a tool on the top of a step ladder?

\_\_\_\_\_

28. What is a problem with carrying large boxes up or down steps?

\_\_\_\_\_

29. What are three things to look for in checking the safety of a ladder?

\_\_\_\_\_

30. What is a rule to follow when determining how far to reach out when working on a ladder?

\_\_\_\_\_

31. How is it determined if a ladder is set at a safe angle?

\_\_\_\_\_

OUTLINE OF INSTRUCTION

- aa. An edge connector mated with its receptacle.
- bb. Various pin-type connectors.
- cc. A typical pin connector installed on circuit board.
- dd. A round pin-type board connector. Note that the flattened, punched end for wire hook-up (on the other end of the plug) is not visible in this slide.

INSTRUCTOR ACTIVITY

- aa. Display Slide YXH L6-S46.
- bb. Display Slide YXH L6-S47,  
NOTE: Keying technique to mating receptacles.
- cc. Display Slide YXH L6-S48.
- dd. Display Slide YXH L6-S49.

STUDENT ACTIVITY

721

381

720

# ANSWER KEY - ACTIVITY A: YOUR SAFETY ATTITUDE

## Model answers

1. A person with a good safety attitude is aware of dangers and uses care before acting.
2. A sixth sense is a feeling which tells us to observe danger before acting.
3. The safety conscious person follows rules, is calm, alert, remembers what he/she is told, and is serious about the job.
4. The accident prone worker shows traits like being a show-off, "hotheaded, lazy, careless, disobedient, forgetful, bored with work, inattentive or "complainer".
5. (Individual responses)

# ANSWER KEY - LEARNING ACITIVITY B: HAZARDS IN USING TOOLS

## Part 1

- |      |       |
|------|-------|
| 1. D | 6. B  |
| 2. D | 7. C  |
| 3. B | 8. A  |
| 4. C | 9. D  |
| 5. B | 10. C |

## Part II

(Individual responses)

# ANSWER KEY - LEARNING ACTIVITY C: PERSONAL PROTECTIVE EQUIPMENT

## Part I

- |    |               |   |
|----|---------------|---|
| 1. | <u>      </u> | A |
|    | <u>  x  </u>  | B |
|    | <u>      </u> | C |
|    | <u>  x  </u>  | D |
|    | <u>  x  </u>  | E |
|    | <u>      </u> | F |
|    | <u>      </u> | G |
|    | <u>      </u> | H |
|    | <u>  x  </u>  | I |
|    | <u>      </u> | J |
|    | <u>  x  </u>  | K |
|    | <u>      </u> | L |
|    | <u>  x  </u>  | M |

- |    |               |   |
|----|---------------|---|
| 2. | <u>      </u> | A |
|    | <u>  x  </u>  | B |
|    | <u>  x  </u>  | C |
|    | <u>      </u> | D |
|    | <u>  x  </u>  | E |
|    | <u>  x  </u>  | F |
|    | <u>      </u> | G |
|    | <u>      </u> | H |
|    | <u>  x  </u>  | I |
|    | <u>  x  </u>  | J |
|    | <u>  x  </u>  | K |
|    | <u>      </u> | L |
|    | <u>  x  </u>  | M |

## Part II

1. A
2. D
3. B
4. B
5. A

6. D
7. B
8. A
9. C
10. B

OUTLINE OF INSTRUCTION

ee. Board connector using flat pins

(1) The discoloration (silver sulphide) is caused by silver migration through the gold plating on top of silver.

(2) Silver under gold is forbidden by MIL-STD-275B.

ff. Fork-type board connector.

(1) Top illustration spring-tension mating.

INSTRUCTOR ACTIVITY

ee. Display Slide YXH L6-S50.  
NOTE: The discoloration on pins.

ff. Display Slide YXH L6-S51.

STUDENT ACTIVITY

388

723

ANSWER KEY - LEARNING ACTIVITY E: PREFERRED SAFETY PRACTICES

Part I

1. T
2. F - Flammable liquids should be stored in metal containers.
3. F - Broken glass should be put in a bag or box before throwing it in a waste container.
4. F - Dress shoes do not serve as safety shoes because they do not have steel toes or inner soles.
5. T
6. F - A box is not a safe device on which to stand. It may slip or break.
7. T
8. T
9. F - Spreading rails indicate that the rungs may be loose.
10. T
11. F - The bottom of the ladder should be 1/4 the distance from the base to the point where the ladder is supported.
12. T
13. F - Guards should never be removed without the supervisor's permission.
14. T
15. F - Wire mesh gloves are used when there is danger of cutting the hand or fingers with a sharp object.
16. F - A knife should be drawn in the opposite direction of the body.
17. T
18. T
19. F - Gasoline should not be used because it could ignite, causing an explosion.
20. F - If clothing catches on fire, it would be best to smother it with a blanket, coat, or by rolling on the ground or floor.
21. T

OUTLINE OF INSTRUCTION

(2) Bottom illustration -  
mounting configurations  
and swaging to printed  
circuit boards.

(3) Individual contacts can be  
replaced, but the swaging  
makes the job difficult.

gg. Fork connectors installed on a  
printed circuit board.

hh. For connectors swaged to the  
circuit board.

ii. Bonding of a single heavy com-  
ponent to a printed circuit  
board for mechanical strength  
and shock absorption.

INSTRUCTOR ACTIVITY

gg. Display Slide YXH L6-S52.

hh. Display Slide YXH L6-S53.

ii. Display Slide YXH L6-S54.

STUDENT ACTIVITY

ANSWER KEY: PRETEST - POSTTEST

1. A. Calmness: A person who thinks through each situation in a calm sort of way is less likely to become injured than someone who is hurried or impatient.  
B. Alertness: The alert worker sees dangerous conditions and acts accordingly.  
C. Remembers instructions: This type of worker remembers safety precautions after being told the first time. Workers who must learn through repeated mistakes are expensive to the company.  
D. Serious about work: The workers who really care about their jobs are less likely to be involved in accidents than careless workers because such workers tend to be more serious about practicing safety regulations.
2. A. Hotheaded: Hotheaded employees will act on impulse, without thinking.  
B. Lazy: The lazy worker will not go through the extra effort of practicing safety.  
C. Forgetful: This type of worker usually forgets safety rules because he/she does not think they are important.  
D. Complainer: This kind of person is always dissatisfied and takes this dissatisfaction out on the company, including disregard for safety.
3. (This will vary, depending on the place of employment)
4. False - Personal protective equipment does not eliminate the hazards but serves to protect the worker from a hazard which cannot be easily corrected; i.e., dust, gas, glare, etc.
5. False - About 12 percent of all industrial injuries are a result of failing to use personal protective equipment.
6. True
7. False - Safety goggles protect only the eyes. Face shields protect the entire face.
8. False - Baffled openings are meant to screen glare or hazardous particles.
9. False - The Wisc Owl Club accepts as members people who saved the sight of one or both eyes by using personal eye protection.
10. True



OUTLINE OF INSTRUCTION

2. Determining extent and type of damage.

a. Type of damage is determined by the portions of the assembly which are affected.

(1) Component damage only.

(2) Coating damage

(3) Conductor damage

(4) Baseboard damage

INSTRUCTOR ACTIVITY

2. Display Slide YXH L6-S55.

STUDENT ACTIVITY

384

727

726

2-4-70

Answer Key: Pretest - Posttest (Continued)

32. Jewelry may get caught in the machinery.
33. Pinch points are spots where it is easy to get a finger or hand pinched or caught. Example: areas between a door frame and a crate.
34. Loose clothing may get caught in the machinery.
35. Another person might not realize that it is unattended, and become injured by moving parts.
36. Wrap in a blanket or coat, or roll on the floor.
37. Oily rags should be placed in a self-closing metal container.
38. Extension cords promote spark hazards as well as being a tripping problem.
39. A wooden ladder.
40. Work on a rubber mat. Use rubber gloves and insulated tools.
41. Separate the victim from contact with electricity by using an insulated material.
42. An eye fountain is needed to wash caustic chemicals from the eye.

OUTLINE OF INSTRUCTION

b. The extent of damage is determined by the nature of the damage to each individual portion of the assembly.

(1) Coatings may be peeled, burned, charred or dissolved.

(2) Conductors may be cracked, nicked, delaminated or missing.

(3) Baseboard may be cracked, broken, delaminated or missing.

3. Evaluating feasibility of repair.

INSTRUCTOR ACTIVITY

3. Ask student the answers to generate participation.

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

- a. Is reliable repair possible with available tools and techniques?
- b. Can board be salvaged at the expense of destroyed components?
- c. Can components be salvaged when the board is not repairable?
- d. Is reliable repair possible at a higher maintenance level (Micro-Miniature Repair Specialist)?

4. Choosing appropriate repair techniques.

730

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

386

731

OUTLINE OF INSTRUCTION

a. After completely evaluating the repair task to be performed, establish a step-by-step repair procedure.

b. Choose available tools and techniques which will most reliably complete each step of the procedure.

J. Inspection repaired printed circuit boards for completeness and quality of repair.

1. Condition of laminate.

a. Inspect laminate material for unrepaired damage.

INSTRUCTOR ACTIVITY

J. Display Slide YXH L6-S56.

STUDENT ACTIVITY

732

733

387

OUTLINE OF INSTRUCTION

- b. Inspect laminate repairs for quality and reliability.

2. Condition of conductors.

- a. Inspect conductors for unrepaired damage.

- b. Inspect conductor repairs for quality and reliability.

3. Condition of eyelets.

- a. Inspect eyelets for unrepaired damage.

734

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

388

735

OUTLINE OF INSTRUCTION

- b. Inspect eyelets for repair quality and reliability.

K. Safety precautions.

1. Workpiece

- a. Never perform any action on the workpiece which will cause damage or degradation.
- b. Handle all workpieces as extremely fragile.

736

INSTRUCTOR ACTIVITY

- 1. Display Slide YXH L6-S57.

STUDENT ACTIVITY

737

389

OUTLINE OF INSTRUCTION

- c. Maintain scrupulous cleanliness at all times.

2. Tool

- a. Clean and store all tools properly.
- b. When using chemicals beware of skin, eye and internal contact and avoid excessive inhalation of fumes.
- c. Use eye protection when using power tools and when there is a chance of splashing chemicals.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

390

739

738



OUTLINE OF INSTRUCTION

- d. Do not breathe dust particles from cutting and grinding operations.
- e. Avoid any possibility of igniting flammable chemicals or materials.

L. Demonstration

- a. Circuit board repair.

INSTRUCTOR ACTIVITY

- a. Instructor should demonstrate the proper techniques and use of tools while showing the student how to install eyelets, make run repairs, pad replacement and board laminate repairs. Covered during the lesson.

STUDENT ACTIVITY

- a. Observe and ask questions if necessary.

740

741

391

OUTLINE OF INSTRUCTION

III. APPLICATION

Performance Sheet 2-4-1P

IV. SUMMARY

A. Introduction

1. Nature of summary.

2. Purpose of summary.

B. Directions to students.

712

INSTRUCTOR ACTIVITY

Supervise each student's completion of Performance Sheet 2.4.1P emphasizing safety.

A. Emphasize importance of the summary for the student.

STUDENT ACTIVITY

Complete 2-4-1P. Ask questions if procedures are not clear.

713

392



FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Minature/Microminiature Electronic Repair  
(2M) Program A-100-0034

Lesson Topic 3.1:  
Soldering to Turret Terminals

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 2.25 Hours  
Laboratory - 5.00 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides

(1) YXH L-8-S1 through  
YXH L-8-S35

3. Training Aids Equipment

- a. Projector, Slide
- b. Screen, Projection, Standard

4. Text

- a. Student's Guide

5. References

- a. MIL-STD-454D
- b. MIL-S-45743C
- c. NHB-53D04 (3A)

TERMINAL OBJECTIVES:

Supported entirely by this lesson topic: NONE

Supported partially by this lesson topic:

- 3.D CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL STD-454D, MIL-S-45743C and NHB 4300.

ENABLING OBJECTIVES

When the student completes this lesson topic, he will be able to:

- 3.1.1 PREPARE turret terminals for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.

- 3.1.2 PREPARE wires for soldering by stripping, tinning, and bending following the procedures and to the standards outlined in MIL-S-45743C.
- 3.1.3 CONNECT prepared wires to turret terminals using the proper tools and soldering techniques following the procedures to the standards outlined in MIL-STD-454D, MIL-S-45743C and NIB 5300.4(3A).

#### CRITERION TEST

The student will be required to perform a minimum of two single and one double entry turret terminal connections using the soldering techniques as outlined in Performance Sheet 3-1-1P and to the standards in MIL-STD-454D and MIL-S45743C.

#### HOMEWORK

OUTLINE OF INSTRUCTION

I. INTRODUCTION

A. Contact

749

INSTRUCTOR ACTIVITY

A. Introduce self and topic.  
Provide for students  
needs.

1. Muster

2. Comfort

3. Visibility and  
seating.

3-1-3

STUDENT ACTIVITY

750

396

OUTLINE OF INSTRUCTION

B. Readiness

751

INSTRUCTOR ACTIVITY

B. Explain value of subject matter, pointing out where appropriate, its relationship to the following:

1. Accomplishment of daily tasks aboard ship.
2. The necessity of the skills and techniques in repair of printed circuit boards.
3. Personal applications of the knowledge and skills.

3-1-4

STUDENT ACTIVITY

397

752

OUTLINE OF INSTRUCTION

C. Effect

753

INSTRUCTOR ACTIVITY

Seek to motivate. Tell a good tie-in story if possible.

C. When following a subject matter topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).
2. Commend students for mastery of skills in previous lesson(s).

STUDENT ACTIVITY

754

866



<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>D. Overview</p> <p>755</p>	<p>0. Overview lesson by:</p> <ol style="list-style-type: none"> <li>1. Stating learning objectives as contained on cover pages to this topic.</li> <li>2. Stating procedures to be followed during the lesson.               <ol style="list-style-type: none"> <li>a. Taking notes.</li> <li>b. Asking questions.</li> </ol> </li> </ol> <p>3-1-6</p>	<p>399</p> <p>756</p>

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

c. Use of criterion test.

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives or procedures if in doubt.

II. PRESENTATION

A. Types, sizes, and usage of turret terminals.

A. Display slide VXH L8-2

A. Take notes ask questions.

1. Common types and sizes.

757

3-1-7

758

004

OUTLINE OF INSTRUCTION

a. Types

(1) Single section.

(2) Multiple section.

(3) Those designed to protrude from one side of the mounting surface only.

(4) Those designed to protrude from both sides of the mounting surface (feed-through types).

INSTRUCTOR ACTIVITY

a. Explain differences

STUDENT ACTIVITY

461

759

760

ED193526

REVIEW AND SYNTHESIS  
OF  
RESEARCH AND DEVELOPMENT IN TECHNICAL EDUCATION

written by

Charles R. Doty  
Department of Vocational-Technical Education  
Rutgers, The State University of New Jersey

Henry E. Tornell  
Postsecondary Education and Research Specialist  
Division of Vocational Education and Career Preparation  
Department of Education  
New Jersey

William Wenzel  
Assistant Commissioner of Education  
Division of Vocational Education and Career Preparation  
Department of Education  
New Jersey

CE 027089

The ERIC Clearinghouse on Adult, Career, and Vocational Education  
The National Center for Research in Vocational Education  
The Ohio State University  
1960 Kenny Road  
Columbus, Ohio 43210

1980

U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

OUTLINE OF INSTRUCTION

b. Sizes

(1) Turret terminals are used  
in many sizes

(2) The terminal size and  
conductor size should  
correspond.

(3) The procedure of placing  
a large component or  
conductor on a small  
turret terminal creates  
undesirable stresses on  
the terminal which may  
lead to unreliability of  
the assembly.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

## FOREWORD

The Educational Resources Information Center on Adult, Career, and Vocational Education (ERIC/ACVE) is one of sixteen clearinghouses in a nationwide information system that is funded by the National Institute of Education. One of the functions of the Clearinghouse is to interpret the literature that is entered in to the ERIC data base. This paper should be of particular interest to researchers, practitioners, and graduate students who are seeking a broad overview of the field.

The profession is indebted to Charles R. Doty, Henry E. Tornell, and William Wenzel for their scholarship in the preparation of this paper. Recognition also is due Terry J. Puckett, Muskingum Area Technical College; Max E. Jobe, East Texas State University; and Dewey Adams, The National Center for Research in Vocational Education, for their critical review of the manuscript prior to its final revision and publication. Robert D. Bhaerman, Assistant Director for Career Education at the ERIC Clearinghouse on Adult, Career, and Vocational Education, coordinated the publication's development.

Robert E. Taylor  
Executive Director  
The National Center  
for Research in  
Vocational Education

OUTLINE OF INSTRUCTION

2. Uses

- a. Turret terminals are used for providing interfacial connections on printed circuit boards.
- b. As terminal points for point-to-point wiring.
- c. For mounting components.
- d. As tie points for inter-connecting wiring.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

403

703

701

## CONTENTS

INTRODUCTION	1
Purposes and Approaches	1
PROGRAM ADMINISTRATION: PLANNING, MANAGEMENT, EVALUATION	10
Articulation	10
Accreditation	12
Decision Systems	15
Manpower Supply	18
Perceptions Toward Technical Education	20
Evaluation	23
Self-Study	26
Cost Benefit and Cost Effectiveness	26
Feasibility Studies	29
Start-Up Concept	30
Advisory Committees	32
CURRICULUM DEVELOPMENT AND IMPLEMENTATION	33
Curriculum Planning and Change	33
Technological Literacy	34
Humanities Curricula	35
Curricula in Reading	36
Mathematics Curricula	37



OUTLINE OF INSTRUCTION

B. Preparing a Turret Terminal for Soldering

1. Cleaning

a. Terminals must be cleaned prior to attaching leads or conductors. Cleaning may be done by:

(1) Adding, then removing new solder from the tinned surface, thus removing oxides.

INSTRUCTOR ACTIVITY

B. Display slide YXH L8-S3

STUDENT ACTIVITY

RESEARCH PROCEDURES AND PRACTICES	75
Job Selection Patterns	75
Military Research	76
Research Priorities	81
Research Matrix	81
SUMMARY	83
Findings of the Review	83
Research Priorities	88
SOME ADDITIONAL RESOURCES	94
REFERENCES	98

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

405

- (2) On new, relatively clean terminals, the use of solvent is often sufficient. If not, the above method should be used.

- (3) Old, used, very dirty, or highly oxidized terminals may require repeated solder coating/removal steps and/or abrasion techniques to properly prepare them for soldering.

- b. If terminals must be handled after cleaning operations, a recleaning with solvent is necessary to remove the oils and salts deposited from contact with the skin.

767

759

The research reported pertains to technical education in the broadest sense. That is, it is not confined to engineering technicians but also includes health, business, agriculture, and so forth, when appropriate.

Five basic criteria were used for the selection of the studies:

1. The study pertains to technical education or contains crucial information for the technical educator.
2. The findings appear to have national significance.
3. The methodology was judged appropriate and thorough.
4. The reports are available through microfiche, microfilm, or hard copy.
5. The studies cited appear representative in a particular area.

Using these criteria, studies were identified using the following major ERIC descriptors:

Accreditation  
Administrative staffing  
needs  
Advisory committees  
Articulation  
Attrition  
Barriers to enrollment  
Bibliographies  
Career choices  
Characteristics  
Computer instruction  
Cooperative education  
Cost benefit  
Cost effectiveness  
Credit for experience  
Credentialing  
Curriculum change  
Curriculum guides  
Decision system  
Enrollment  
Evaluation  
Feasibility study  
Follow-up  
Handicapped  
History  
Humanities curricula

Individualized instruction  
Instructor staffing needs  
Prediction  
Job prospects  
Job satisfaction  
Job selection patterns  
Licensing  
Manpower supply  
Math  
Methodology for needs  
determination  
Mobility  
Needs survey  
Occupational competency  
examination  
Perceptions toward technical  
education  
Performance based instruc-  
tion  
Personnel problems  
PPBS  
Reading  
Research priorities  
Residential centers  
Retired technicians  
Review and synthesis

OUTLINE OF INSTRUCTION

2. Tinning.

- a. Terminals must be tinned prior to soldering. This enhances the flow of solder and aids in the formation of a reliable intermetallic bond.
- b. The solder coating/removal steps involved in the cleaning process provide a good tinned surface.
- c. For tinning a new terminal, the application of flux and fresh solder with the proper heating to cause the solder to wet thoroughly is required.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

Science and technology are not widely understood by the general public because they seem remote from people's everyday lives. If we search for new ways of involving citizens as they are affected by technical programs, we may find better ways to enlarge public understanding of science and technology. (p. 1)

The environment in which technical education exists is global; industrial nations are relying more and more upon technicians. However, world-wide and national reports indicate that there are not enough technicians to meet the demand and that often there is a mismatch between available technicians and demand. Before the review of research can be considered, therefore, the term "technician" must be defined.

The most appropriate way to define technical education is, first, to cite an industrial definition of a technician and then to see how educators have constructed curricula to produce this type of worker. It should be noted that graduates of certificate and two-year technology programs are generally designated "technicians" while graduates of comprehensive four year colleges are designated "technologists." It is also appropriate to show the spectrum of education within which a person becomes a technician.

In 1975, the General Electric Company published a booklet called "What's It Like to be a Technician?" The booklet, produced for students and the public, included the following statement:

There is no generally accepted definition of the term "technician" that covers all phases of work. The terminology varies from occupation to occupation, employer to employer, and even job to job. Yet, there are many things common to all technicians.

They all play essentially a supporting role, often requiring close work with scientists, engineers and other professional personnel.

Technicians are doers. They are...among the prime movers in converting ideas into accomplishments.

On the other hand, the Engineers Council for Professional Development (ECPD), in explaining its concept of work and preparation of engineering team members, described five principal types of technical members, namely, craftworkers, technicians, technologists, engineers, and scientists. The ECPD descriptions of the technician and engineering technologist were as follows:

OUTLINE OF INSTRUCTION

C. Preparing Wire for Soldering to Turret  
Terminals

1. Tools used

- a. Mechanical and thermal wire  
strippers
- b. Soldering iron
- c. Antiwicking tools (tweezers,  
"Little Joes")

771

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

407

772

3-1-14

a growing number of technical educators are communicating with each other.

- Military-sponsored research is more sophisticated and thorough than research sponsored by other agencies.
- Accreditation will become more important in the future because of competition from nonpublic educational agencies and businesses, limited enrollment of students, competition between community colleges and four-year institutions, and accountability.
- The needs of administrators of technical programs have barely been considered. The National Center for Research in Vocational Education has just begun its staff project, Personnel Development for Local Administrators.
- The subject of advisory committees has been neglected in recent years by researchers.
- Articulation of educational/technical programs is one of the most critical problems. Many states have both a state Department of Education and a state Department of Higher Education along with other separate administrative bodies. In many instances, articulation has broken down between agencies due to political situations.
- Attrition is another program. The movement throughout the country for increased accountability and evaluation of programs ensures that problems associated with these areas will need to be addressed.
- Studies on barriers to enrollment are just starting. Although it is expected that studies concerning special populations will be conducted in the future, it should be noted that no studies were readily available on such physical barriers to participation in training.
- There are few research studies on career choices, women in technical education, and credit for experience. There are descriptions of programs and expressions of opinion - but little research. However, there are several studies on student characteristics which might be profitable to examine. The research in these areas is fragmentary and would lend itself to a major study which would consolidate and build upon all existing information.
- The use of computers and computer instruction paralleling the rapid expansion of computers in industry has not been



OUTLINE OF INSTRUCTION

d. Vise

e. Round nose pliers

f. Nylon rod

g. Flush-cutting pliers

h. Soldering iron holder

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

773

774

804

in teaching and curricula occurred as a result of the follow-up studies.

- The possible need for humanities curricula within a technical education program should be studied.
- Individualized instruction seems to have received some attention, but it merits more. The requirement in some states to have individual prescriptions (educational objectives) for each student may affect this area.
- The problem of adequate manpower data for decision making has been addressed by the creation of the National Occupational Information Coordinating Committee (NOICC) and the State Occupational Information Coordinating Committees (SOICCs). The questions that arise are, Will these committees be able to coordinate the data from the numerous federal, state, and local agencies? Will federal, state, and local agencies use the data generated for decision-making?
- The problem of worker attitudes toward mobility and jobless benefits needs further research. The majority of technical graduates remain in the local area. The large numbers of studies on different populations' attitudes toward all types of situations need to be viewed critically. Why are these studies done? What purposes do they serve? What problems are solved due to these studies? Are these studies done so educators can compliment themselves?
- Since the early 1960s when the precise writing of educational objectives specifying expected student behaviors was emphasized, educators have been encouraged to write philosophies, goals, and educational objectives. Yet Maney (1972) found that PBBS (Performance Based Budgeting System) could not be implemented in a selected school because of inadequately specified goals and objectives. Many questions need to be answered concerning the ability of educators to write philosophy, goals, and educational objectives and the willingness and ability of educators and business managers to implement PBBS.
- The "back to basics" movement probably will result in many studies in reading and math for technical students. Many remedial programs have been implemented but may not have been studied systematically to determine what effects, if any, they have had.
- Other states might follow the example of North Carolina and Wisconsin and systematically determine research

## OUTLINE OF INSTRUCTION

### 2. Stripping

- a. The wire is stripped CAREFULLY, using either an approved style of mechanical wire stripper or the thermal strippers.. (chemical stripper for varnish)
- b. Nonapproved wire strippers. Even though this stripper is adjustable, it is not precision enough to prevent damage to the wire. Also, if the wire is pulled through the blades at an angle, scraping or scratching of the wire surface will occur.

## INSTRUCTOR ACTIVITY

- b. Display slide YXH L8-S4. Tell why not approved.

## STUDENT ACTIVITY

bah

775

## **PROGRAM ADMINISTRATION: PLANNING, MANAGEMENT, EVALUATION**

Research in the area of program administration of technical education included a wide array of studies dealing with various aspects of planning, management, and evaluation. The studies reviewed below specifically included those dealing with articulation, accreditation, decision systems, manpower supply, perceptions toward technical education, evaluation, self-study, and cost benefit/effectiveness research. This section also includes a report of a feasibility study, the start-up concept, and a brief look at advisory committees.

### **ARTICULATION**

Bender (1973) discussed the separation which exists between vocational, technical, and academic education and between secondary and postsecondary institutions. He suggested that mistrust among educators must be eliminated, and greater articulation between levels and subject areas must be established. Bender reviewed the evolution of this separation and reported the findings of two national surveys of chief officers of vocational education and junior community colleges. In summarizing the two studies, he stated that

...the picture is clear. Separation still exists with the nature and degree of difficulty in articulation directly related to the relationships of the agencies involved. Where vocational and technical education and postsecondary institutions such as the community colleges are under the same organizational structure, the likelihood is greater that articulation is being fostered from the state through the local and institutional levels. State organizational structure has a significant impact on the articulation of secondary and post secondary education. (p. 28)

Bushnell (1978) directed the American Association of Community and Junior Colleges and American Vocational Association (AVA) Joint Study on articulating postsecondary occupational education. The four broad objectives were (1) to identify procedures and

OUTLINE OF INSTRUCTION

- c. Other types such as the combination "wire stripper, crimper, and bolt cutters" are also nonapproved.
- d. Mechanical strippers of the nonadjustable, factory set type should be used when thermal strippers are not available.
- e. Approved type of mechanical wire strippers to be used. These strippers have the non-adjustable, factory set provision blades to provide reliable stripping without damage when used with CARE.

INSTRUCTOR ACTIVITY

- e. Display slide YXH  
L8-S5

STUDENT ACTIVITY

the practices given high ranking in value were not necessarily used by the responding institutions. In addition, the occupational education administrators viewed articulation of occupational education on the local level as primarily the responsibility of local leadership.

Keeling (1973) examined whether the organizational design of the health occupation program in junior community colleges was related to the opinions of health occupations personnel toward articulation. Based on a survey of ninety-eight institutions in nine states, Keeling found three organizational patterns: all health programs combined in one department, each health program operating separately, and nursing split from programs of other health occupations. A stratified sample of twenty-eight colleges from the original ninety-eight was selected for an indepth survey of opinions toward articulation. The persons under the separate organizational structure indicated more agreement with articulation than those in other systems. Therefore, organization did appear to affect personnel opinions toward articulation.

Roy's study (1972) of articulation of occupational programs from the North Carolina public school systems through the community college system included a survey interview of 200 elementary school students, 925 secondary school students, and 125 randomly selected teaching and guidance personnel of both systems. He found some elements of articulation in the business education area; however, little or no articulation among other curricula was evident. He concluded that until some means of removing the barriers between departments of education is implemented, the organizational structure will further hinder articulation.

Articulation has received little attention from researchers. The research published merely emphasizes (1) that separation exists among levels of institutions and associations and (2) that the AVA and AACJC have realized this situation and have made one attempt to reduce separation. Until state organizational structures are designed to eliminate separatism among institutions, articulation will continue to be hindered.

#### ACCREDITATION

Ward (1970) conducted the first national comprehensive study of accreditation. The study was initiated because of the burden placed upon accrediting agencies to evaluate occupational education and because of the relative experience of many of these agencies in the area of occupational education. The study

### OUTLINE OF INSTRUCTION

f. These strippers should be inspected frequently to ensure that the blades are sharp and have not become misaligned.

g. Mechanical strippers should not be used on wire sized AWG-22 or smaller. The mechanical advantage of the stripper is such that the smaller sizes mentioned may be stretched by the pulling action as the insulation is removed.

h. Any damage to the wire caused by stripping is grounds for rejection. The damaged area shall be removed and the wire restripped (cuts, scrapes, nicks or "birdcaging")

### INSTRUCTOR ACTIVITY

g. STRESS why strippers should not be used on wire size AWG-22.

### STUDENT ACTIVITY

111

779

780

in self-study.

Mellinger (1972) sought to identify areas of concern in technical institute accreditation. To do this, he analyzed sixty-nine reports containing 1,631 comments of accreditation evaluation teams of two regional and four specialized agencies. A mailed survey of ninety-three technical institute officials in the region also was conducted. The report analysis showed several common weaknesses, e.g., inadequate library holdings, physical facilities, excessive teaching loads, and lack of formal policies and procedures. The survey revealed that institutional officials believed the accrediting agencies did not fully understand the philosophy, purposes, and operational characteristics of the institutes. The findings were consistent with Ward's study (1970).

Messersmith and Medsker (1969) conducted a study of accreditation problems concerning technical curricula in community colleges. Three questions were addressed: (1) To what extent are specialized agencies now approving curricula in two-year colleges? (2) Is there evidence that specialized accreditation either inhibits or promotes the development of occupational programs? (3) Does the specialized agency have concerns related to standards and the level of training given by institutions?

Forty-three community colleges in eighteen states were surveyed, plus five professional associations found to be most active in two-year college programs. Analyses were made on 315 returns. When compared to earlier studies, the data showed that specialized accreditation in two-year colleges had declined. The institutions also felt that neither accreditation per se nor the accrediting agency was of much value to new programs. They felt that while an accredited program attracts better students, accredited status is of little value in placing graduates. It was suggested accrediting agencies reevaluate the assistance they are giving. The following questions for further research were presented: What are the potential points of tension in the accrediting process? What is the existing state of tension among parties involved in accrediting? Is it possible to discontinue mandatory accreditation for purposes of program approval?

The state-of-the-art of accreditation of occupational programs, as revealed by these studies, reflects inadequacy and even conflict regarding the status of occupational education in higher education. However, since these studies are dated, they may not reflect present conditions.



### OUTLINE OF INSTRUCTION

- i. Thermal wire stripper. This is a bench model for production line work. There are many other types of thermal strippers, but all work is by the same melting action to remove the insulation.
- j. Thermal strippers should be used whenever possible as the chance for wire damage is minimized.
- k. Wire is inserted into the jaws of the thermal strippers. Some models have an adjustable stop to provide a repetitive strip length, and some have an adjustment for depth of jaw cut.

### INSTRUCTOR ACTIVITY

- i. Display slide YXH L8-S6
- k. Display slide XYH L8-7

### STUDENT ACTIVITY

What is the real basis for decisions? political considerations? individual egos? organizational imagery? real or imagined needs? relevant data? or some combination of these? What is the real basis for decisions in educational institutions? Research indicates that the quality of the decision is directly related to the amount of information used in making that decision.

While there is no doubt that the good judgment of the decision maker is essential, that good judgment can be supplemented by relevant, accurate and timely information. This study is an attempt to develop the blueprint for an information needs assessment for occupational education for California community colleges. (p. 1)

Using the Delphi technique, she identified 111 persons (eighty-eight men and twenty-three women) as management team members for occupational education in eight community colleges representative of all the California state's colleges. Data was collected on eight decision areas, including program goals, advisory committees, program planning, and operational budgets. A total of 193 information factors were generated concerning these areas. The statistical analysis indicated a significantly high relationship between institutions and their management teams' perceived importance of information factors needed for effective planning in occupational education. The ranking given by the teams indicated that information factors relating to commitment and attitudes were most important. In rank order they were as follows:

- Commitment of board and top administrators to occupational education
- Knowledge of anticipated technological and industrial job requirements
- Facilities and equipment required and available to meet objectives
- Community needs--current and anticipated
- Number and qualifications for faculty members to accomplish objectives
- Input from current and former students. (p. 10)

Bowers succeeded in developing a blueprint for an information needs system. A major point of her study was that, in order to

### OUTLINE OF INSTRUCTION

1. In operation, the jaws are closed GENTLY on the wire and power is applied. The wire is then turned approximately 90 degrees when the melting action becomes visually apparent.

- m. When the jaws have melted through the insulation creating a cut completely around the circumference of the wire, the jaws are opened and the wire removed. Note that the action desired is to MELT through the insulation, NOT burn through. Burning will damage the insulation and cause rejection of the wire.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

413

731

783

## MANPOWER SUPPLY

It should be noted that the Vocational Education Amendments of 1976 [P.L. 94-482, Section 161 (b)] mandated the establishment of a National Occupational Information Coordinating Committee (NOICC) and State Occupational Information Coordinating Committees (SOICCs). The SOICCs were required to be in existence by October 1, 1977. NOICC was established to coordinate all the job information banks operated by the Department of Labor to create a system of uniform programs, occupational information, and employment data using standardized definitions and descriptors. In addition to the requirements for coordination of labor market information, the Ninety-fourth Congress addressed the need for better planning and accountability data by mandating a national Vocational Education Data System (VEDS) to be developed and operated by the National Center for Education Statistics.

Occupations in Demand is a relatively new publication of the Department of Labor. The content of this publication is based on a monthly survey of 2,400 job service offices dispersed nationally. The format contains a list of the number of openings available, average beginning pay, and cities where demand is greatest. The newsletter includes a description of jobs requiring a trade or technical skill, those requiring a college degree, and those needing a high school diploma or less. Statistical data relevant to technical education (and other education) on a national basis are available from the National Center for Education Statistics in two publications, The Condition of Education (1976 edition) by Golladay and Digest of Education Statistics (1975 edition) by Grant et al. These reports have indicated increasing growth for professional, technical, and clerical workers. Other occupational areas, e.g., farm occupations, have been projected as "status quo" or decreasing.

Rhine and Creamer (1969) of the National Industrial Conference Board produced a well documented publication called The Technical Manpower Shortage: How Acute? Persons researching manpower should examine this document as a reference point. In response to the critical shortage of trained technicians in the late 1960s, Rhine also produced Technician Education--Who Needs It? (1969). The result of this investigation was the popular publication called 25 Technical Careers You Can Learn in Two Years (USOE, n.d.). Over 470,000 individuals have requested this publication prior to 1970, and it is still being distributed in revised format.

### OUTLINE OF INSTRUCTION

- n. Insulation being removed with the fingers. The insulation must be allowed to turn and follow the lay of the wire strands during this operation to prevent birdcaging of the wire. DO NOT change the rate of twist of the wire in the stripping process.
- o. Results of correct wire stripping. (Note the wire strands are not disturbed)
- p. Chemical stripper used to remove varnish type insulation from magnet wire.

(1) Dip wire in chemical.

### INSTRUCTOR ACTIVITY

- n. Display slide YXH  
L8-S8
- o. Display slide YXH  
L8-S9
- p. Display slide YXH  
L8-S10

### STUDENT ACTIVITY

environmental problems would create the need for 214,000 technicians. At the 1972 rate of enrollment, the number of graduates available to fill 1980 needs would fall far short of the required number. Fish found that, in 1972, it was not feasible to institute an environmental technician program based on local needs data. Industry generally preferred graduates with broad skills in drafting, physics, electronics, chemistry, biology, communications skills, safety knowledge, and respect for the environment.

Braden and Paul (1971) conducted a manpower study of a seventeen-state area and Puerto Rico to determine availability and need in the nuclear industry. Their research questions pertained to the magnitude of employment, estimated demand, existing training programs, employment patterns of graduates of nuclear training programs, and characteristics of the paraprofessionals. They found that between 1971 and 1975 a demand of approximately 3,280 nuclear related technicians per year existed. The areas were in power production, testing, monitoring, and health. The total employment as of 1971 was 8,547 jobs. They found fifty-five training programs in schools, eighty-two programs in hospitals, and 180 programs in industry. A telephone interview of ninety-nine graduates from twenty different programs revealed that 71 percent took jobs in a field directly related to their education, 5.4 percent went into military service, 9.4 percent transferred to other institutions, and 3 percent were unemployed. Characteristics of nuclear technicians differed greatly. For example, health related technicians were younger, had more formal education, and had more experience related to their jobs. Non-health-related workers had most of their training on the jobs and had more work experience in jobs outside the field.

The information reported here illustrates the crucial need for manpower information systems which yield data based on consistent definitions, both nationally and in each state. Without reliable data, decision making becomes guesswork. The emergence of new occupations, changes in existing occupations, and the cycling of need for manpower in occupational areas (that is, high demand to no demand) has been reflected in the research by the federal Department of Labor, TERC, AACJC, Fish, and Braden and Paul.

#### PERCEPTIONS TOWARD TECHNICAL EDUCATION

In cooperation with the American Association of State Colleges and Universities (AASCU) and the National Association of State

• OUTLINE OF INSTRUCTION

(2) Allow 3 minutes for softening.

(3) Use disposable tissue to clean (Kimwipe).

(4) Neutralize exposed wire with water or solvent.

q. Results of chemical stripping.

3. Tinning

INSTRUCTOR ACTIVITY

q. Display slid YXH L8-S11

3. Display slide YXH L8-S12

STUDENT ACTIVITY

415

753

787

wrote, "It is becoming more apparent that a crucial element in sound planning for the development of a relevant curriculum for vocational education is the body of sentiments--opinions, feelings, values and reactions--of persons most directly affected by the institution" (p. 1).

His survey was designed to measure a broad sweep of industry respondents' opinions, from very general attitudes about graduates and sources of dissatisfaction of employees to quite specific perceived preferences of social and technical skills. It does not seem surprising that he found responsibility and honesty ranked one and two respectively by a wide margin over the other thirty-four social skills identified. Personal traits also were studied. The first five, in order of priority as ranked by industrialists, were (1) follows directions carefully, (2) completes assignments, (3) cooperates with supervisors, (4) works with accuracy, and (5) uses time efficiently. All attitudes, expectations, and identification of general and specific technical skills were reported by occupational program. A minimum of fourteen technical programs were reported. A unique aspect of the study was that college instructors interviewed the employers.

Ammadi (1971) found that no studies had been conducted with regard to the perceptions of objectives for the agricultural occupations curricula at the junior college level among teachers and students. His instrument, developed to measure the connotative meaning of the course objectives, was a semantic differential. The basic concern was to determine if differences existed between the two groups concerning courses in agricultural production, agricultural mechanics, and agricultural business management. The conclusion was that the two groups generally had the same perceptions.

The South Carolina State Advisory Council (1976) conducted a study to determine employer perspectives of technical centers and colleges and vocational education in the state. A consulting firm was contracted to do the research. The sample was 1,200 (12 percent) of the largest employers in the state. However, the consulting firm seemed to draw overly-optimistic conclusions from the responses. For example, the following question was asked: "To what extent are the technical education college/centers meeting the occupational needs of the students?" Fifteen percent (175 employers) marked "To a very great extent;" 49 percent (565 employers) indicated "to a great extent;" and 26 percent (306 employers) answered "To somewhat of an extent." The consulting firm concluded that "Nearly all thought the technical colleges/centers were meeting the occupational needs of the students to a great degree or replied neutrally" (p. 10). An indicator of 90 percent



OUTLINE OF INSTRUCTION

- a. Tinning of the wire is required to prevent damage in the bending operation and to enhance the flow of solder during the soldering operation.

- b. One method of tinning the wire. Note the use of antiwicking tweezers to prevent solder wicking up under the insulation due to capillary action.

- (1) The operation is performed by bringing a clean, dry soldering iron in behind the wire, one third to one half the distance down from the antiwicking device.

INSTRUCTOR ACTIVITY

- b. Explain how to tin wires to meet standards.

STUDENT ACTIVITY

components exist in a program. It was explained that, with this supporting information, an evaluator can more correctly interpret evaluation data. This model, which applies to technical education programs as well as other programs, contains fourteen components: descriptive information, demonstration of need, student recruitment and selection, curriculum, guidance, placement, facilities, community involvement, youth organizations, cooperative programs, program's effect on students holding power and popularity, satisfaction of various audiences with program, and program staffing and administration. Each component contains questions concerning a specific program.

In 1976, the Florida State Advisory Council on Vocational and Technical Education conducted a study to measure success of thirteen selected programs. The study represented an attempt by the Council to identify valid and reliable sources of data for evaluation of program effectiveness. The programs selected were those which require students to pass licensing examinations; the percent of graduates passing the licensing examination was one measure of success. Among the programs were dental hygiene technology, emergency medical technology, physician's assistant, professional nursing, practical nursing, mortuary science, commercial pilot, airframe mechanic, and power plant mechanic. The report contained separate sections on each occupation, including a job description, license requirements, training programs, and review of data. A review of the licensing requirements for the programs revealed that many of the programs had similar requirements. There were, however, no clearcut statements of success or failure of programs, only inferences which weakened this study.

Dagenais (1974) was concerned with the process of judging vocational program success. He designed a procedure for identifying successful programs using the Delphi method. The design provided for a reliability check through the use of two independent Delphi panels. Each panel consisted of eleven members: the dean, representatives from the board of trustees, advisory board representatives, vocational and academic curriculum advisor(s), admissions office person, and two students enrolled in vocational and transfer programs. The Delphi method consists of three steps: (1) panel members select the five most successful vocational programs using personal criteria; (2) panel members select three programs after reviewing the first round ratings and members' criteria for such ratings; and (3) panel members examine the reasons given for identification of successful programs in the second step and then rate those reasons in terms of their relative importance to program success. Data from sixteen participating community college campuses were analyzed using correlation tests. Dagenais found that the successful vocational programs in his sample

### OUTLINE OF INSTRUCTION

- (2) Solder is applied at the junction of the iron and the wire, and allowed to soak into the wire.
- (3) The iron and solder are then moved up the wire toward the antiwicking device.
- (4) When the iron and solder reach the antiwicking device, hesitate momentarily and continue to flow in solder, then work back down and off the end of the wire carrying any oxides removed by the flux off the wire.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

417

792

791

## SELF-STUDY

The South Carolina State Board for Technical and Comprehensive Education (1976) was one of four state agencies for two-year colleges to participate in a pilot self-study project. A self-study manual was developed and approved by the National Council of State Directors for Community and Junior Colleges. Although many questions in the manual refer to "junior" or "community" colleges, the issues raised were pertinent to the technical college coordination and administration with the South Carolina technical education system. The board examined its operations in the following areas: goals, scope, and legal responsibilities; organization and responsibility; planning and research; finances; external influences; relations with constituent institutions within the system; and management information systems. The report is an excellent document for persons preparing for a self-study as well as for those wishing to gain an overall perspective of the South Carolina technical education system and their recommendations for change as a result of the self-study.

## COST BENEFIT AND COST EFFECTIVENESS

The area of costs has been studied in the past in terms of both benefit and effectiveness. This has now become a national priority due to a weakening of the economy and a proliferation of agencies offering technical education. Vocational and technical educators, in the past, generally have not been required to determine cost per student for each course or program. In order to justify their existence, they are now being forced to do so, as specified in the recent legislation, PL 94-482. This topic by itself deserves a review and synthesis publication.

Persons pursuing this topic might refer to Project Baseline's fifth national report, Learning a Living Across the Nation (Lee, 1976) and Model for Cost Per Pupil (Gasior et al., 1975) for a bibliography of major studies on cost up to 1975. The final report, National Priority Training Project: Developmental Strategies and Evaluation Techniques for Improving the Cost-Effectiveness of Vocational Programs: July 1, 1977 - June 30, 1978 (Kim, 1978), might also prove useful. Another report of value in this area is the document prepared for the Florida State Department of Education, Cost of Vocational and Adult Education Programs, by the Institute for Educational Finance (1975). This study provides information on costs of vocational

8

OUTLINE OF INSTRUCTION

c. Alternate method of tinning wire.

- (1) Melt fresh solder on the clean, dry tip.
- (2) Lay wire into molten solder while adding solder to the top of the wire (hold more vertical than shown).
- (3) When the solder is seen to soak into the wire, move the wire in the same manner as in the previous method of tinning, hesitating next to the antiwicking device, then back the wire through the solder until the cut end is reached and then off the iron.

INSTRUCTOR ACTIVITY

c. Display slide YXH  
L8-S13

STUDENT ACTIVITY

benefit; however, no criteria of quality for the indexes have been established. Longitudinal research (field testing) will have to be conducted to quantify the index numbers.

Sewell (1974) conducted a cost benefit study of 1973 graduates and persons who had applied but did not attend the Southwest Wisconsin Vocational-Technical Institute's account clerk and business administration-accounting programs. Sewell included in the report a clear and concise review of the literature on cost benefit analysis from 1964 to 1973. From this, a study was designed to identify and determine the private economic and noneconomic benefit and cost variables.

The private economic benefit variable was income. The private economic cost variables were books and supplies, room and board, fees, transportation, and foregone earnings. The private noneconomic cost and benefit variables were satisfaction with the community; convenience/inconvenience; and attitudes toward education, present job, and making a decision as to a lifetime occupation. It was found the average payback periods, i.e., what it costs to attend school, were from 5.6 to 6.67 years, depending on the occupational program. Graduates, as compared to nonattendees, were more satisfied with their community, and a greater percentage were employed. Sewell found that 42.1 percent of the graduates felt that the benefits of vocational education were worth more than the costs. She concluded that education at the technical institute was a worthwhile investment for the graduates when their levels of satisfaction were compared with those of the nonattendees.

Schwartz (1973) designed a study to compare the costs and the effectiveness of five occupational programs offered by the San Diego Community College and five industries in San Diego. The programs were auto mechanics, data processing, dental assisting, electronics technology, and marketing sales. The purposes of the study were to describe the objectives of both education settings, develop and field test a model for determining per-student cost, and compare the programs on such criteria as cost, placement, salary, and additional training needed by college graduates. The following represent selected findings based on interviews and two surveys: (1) Industry claimed to emphasize many community college objectives, but emphasized them only to accomplish their own goals. (2) For methods of instruction, community colleges depended primarily on lecture and supervised practice, while industry used on-the-job training. (3) Industry training tended to be unplanned, while community college training was more structured. (4) Community colleges were concerned with career training, but industry concentrated only on training for the specific job. (5) The percentage of persons completing industrial programs was far greater than those

OUTLINE OF INSTRUCTION

- d. For best results in tinning, the iron must be at full line voltage. A flat faced tip should be used.

4. Bending

- a. Any method may be used for bending that does not damage the wire in any way.

(1) Round nose pliers

(2) Nylon rod

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

4/4

795

795

general medical practice.) The investigation covered selection procedures, curriculum, space, facilities and equipment, authorization to practice and to dispense drugs, reimbursement and employment, resources necessary for program to be implemented, geographical areas to be served, candidate requirements, and expected results of the program. It was concluded that a fully accredited program could be offered by a community college or technical institute in North Carolina and should consist of a twenty-four-month curriculum and nine months of preclinical courses. Other conclusions concerned administrative and instructional staff, facilities, financing, area to be served, and potential employment sites.

Leavitt (1970) conducted a feasibility study of vertical extension of technical education to determine attitudes toward expanding the two-year engineering technical program into a four-year degree in the community college. His study included faculty, administrators, and students in the community and the state college systems and industrial personnel. All groups, except the community college administrators, favored the vertical extension. This finding was not surprising in view of the basic philosophy underlying the community college - that is, a community college should remain a community college.

Baker (1970) reported that his study originated when a representative from a local business firm visited the electronics facilities at Jefferson College in Missouri and suggested that the dean of technical education give serious consideration to the idea of providing a training program for electronics calibration technicians. The study was made to determine the number of companies in the north central region of the country, the number of technicians employed, the anticipated demand, the present number of students, and the equipment being used in industry.

Feasibility studies are not research studies that have wide generalizability. They usually are completed within a limited geographical or economic area to determine what educational programs should be offered. Of the previous studies mentioned in this section, Minette's provided the best guide for a feasibility study.

#### START-UP CONCEPT

Van Cleve (1976) examined the "start-up" industry training concept in South Carolina, North Carolina, Virginia, and Alabama. He focused on its effect on industrial relocation trends and the "leapfrogging" of the unemployed and underemployed into the



OUTLINE OF INSTRUCTION

(3) Dummy terminal

- b. Round nose pliers being use to bend wire. Care must be used with this method to prevent denting or otherwise damaging the wire.
- c. Nylon rod used to bend the wire. It is not necessary to use the antiwicking device and, if not used with extreme care, the device itself may be damaged.
- d. Dummy terminal used to bend the wire. If this method is used on the terminal to be soldered to, damage to the terminal may result.

INSTRUCTOR ACTIVITY

- b. Display slide YXH  
L8-S14
- c. Display slid YXH  
L8-S15
- d. Display slide YXH  
L8-16.

STUDENT ACTIVITY

human resource development, any discussion of the human resource development cost-benefit ratio also becomes moot. The programs are, as advertised--excellent industrial relocation sales tools. They are an indirect subsidy to industry, offered in competition with other states and locales as an inducement for relocation into an area where successful programs have been inducted in the past. (p. 92)

Van Cleve stated that the start-up industry training programs can work if states assist industry via industrial subsidies to reorient the programs toward human resource development. To accomplish this reorientation, he suggested that each state establish an independent agency, adequately funded, that would be responsible to the state's chief executive officer and legislature.

#### ADVISORY COMMITTEES

Prior to 1969, one can find numerous studies on advisory committees. Perhaps the area was saturated, causing a lack of research in the area at that time. Douglas (1973) had the only fairly recent study uncovered by the reviewers. The study was based on assessing, through the survey instrument, the needs and effectiveness (as perceived by the program chairpersons) of technical and vocational advisory committees in fifty-nine Texas community colleges. No significant factors were found concerning perceived effectiveness. However, Douglas recommended further research to determine why certain types of people, such as union representatives, were excluded from the advisory committees.

### OUTLINE OF INSTRUCTION

#### D. Turret Terminal Solder Connection Specifications

##### 1. Wire wrap

- a. In all cases for turret terminals, the minimum wrap around the terminal shall be 180 degrees (one half turn)

- b. Maximum amount of wrap depends on wire size, as follows:

- (1) AWG-26 and smaller may be 360 degrees (one full turn)

### INSTRUCTOR ACTIVITY

- a. Display slide YXH L8-S17

- b. Point out on slide wire wrap specs.

### STUDENT ACTIVITY

121

800

799

the Forty-first Annual Report of the Engineers Council for Professional Development (1974). It contains useful guidelines for associate and baccalaureate technology degrees, as do the more recent annual reports of both of these groups.

The New Jersey Department of Higher Education created an advisory council on industrial and engineering technology in order to develop their state master plan (1978) for the education of technicians and technologists. An examination of other state plans revealed that the New Jersey plan is more thorough than most.

Borgen and Davis (1971) reported research on the Illinois Occupational Curriculum Project. Their purpose was to develop systems models for curriculum development and evaluation in occupational education. Several conclusions were presented, as indicated below. (1) Alternative strategies for curriculum development may be divided into Tylerian models, systems models, and product development models. (2) The state-of-the-art in curriculum development shows little forecasting power. (3) Curriculum development depends upon educational or training demands, institutional, material and/or human capability demands, and necessary conditions for learning and instruction. (4) Occupational analysis is a tested and proven procedure. (5) Curriculum models usually have weak evaluation components. (6) Regardless of the nature of a model, tradition suggests that four parts must be included, that is, objectives, organization of content for student learning, alternative strategies of instruction, and internal and external evaluation of process and product. Their conclusions seem as pertinent now as they were when they made them.

#### TECHNOLOGICAL LITERACY

Hales (1972) studied the problem of identifying facts, principles, concepts, and laws considered essential for technological literacy of high school graduates. He used the Delphi technique and a panel of ten interdisciplinary scholars in his study. The items listed and classified represent the elements of technological literacy as perceived by the "experts." His use of the Delphi technique consisted of five steps: (1) Each member identified those terms necessary for literacy; the ten lists were then compiled. (2) Each member suggested deletions or additions. (3) Each member classified each of the terms according to the broad area of technology it seemed to represent — transportation, communication, production, science, social and cultural technology. They also classified each term according to Bloom's taxonomy (terminology, facts,

OUTLINE OF INSTRUCTION

(2) AWG-24 and larger may be 270 degrees (three-fourths turn)

c. The perferred wire wrap is 180 degrees

A tinned wire bent and cut to specifications. Observe that the wire is properly tinned; you can see the contour of the wire strands, and there is no evidence of nicked conductors or birdcaging. Note that tinning does not extend all the way to the insulation.

INSTRUCTOR ACTIVITY

d. Display slide XYH L8-S18

STUDENT ACTIVITY

characteristics differ and must be recognized by establishing student services. Her major conclusion was that postsecondary occupational curricula is at two extremes - rigorous baccalaureate level and specific training for jobs. Because of this, she strongly urged that a compromise position be reached.

These studies report the status of humanities curricula in occupational programs and basic skills prior to 1971. Based on current educational and social problems, it is surprising that the literature does not reveal greater numbers of studies. Perhaps educators have been so busy writing institutional master plans and developing basic skills programs that they have had little time to research such areas. Edwards' study (1971) is an example of the research that was expected. He measured human relations competencies needed by industrial technology management and supervisory personnel in Indiana industries. A jury of experts assisted in designing an instrument which sought judgment values for 290 items. Out of 240 companies surveyed, 67 percent replied. Major findings revealed a continuing demand for personnel with broader backgrounds. No respondents considered social competencies to be unimportant. The highest values were placed on understanding human behavior. Company size did not affect responses.

#### CURRICULA IN READING

Karnes and Ginn (1976) administered the Nelson-Denny reading test to students from sixteen vocational and technical areas in seven junior colleges in Mississippi. A forecast readability formula developed by Klare was used to determine the readability level of each of the 230 textbooks used in the postsecondary vocational-technical courses. Results showed that the mean reading level of all students varied from one to four grade levels below the mean readability levels of texts used. Although the results of the study can be questioned on the basis of the small sample taken from the reading level in each book, nevertheless, with the present trend toward "back to basics" it is expected that studies in this area will be conducted more frequently.

Cheshier (1974) conducted a survey of electronics communications technology instructors in order to determine the status, need, and requirements for a textbook in this field. The sample included twenty-five institutions accredited by the Engineer's Council for Professional Development (ECPD) and a similar number of institutions listed in the American Junior Colleges Directory

OUTLINE OF INSTRUCTION

e. The size of the bend made shall be such that the bend will fit firmly against the terminal post throughout the wrap, and cover a minimum of 180 degrees.

f. Wire improperly tinned and bend

(1) Uneven bend will not fit firmly against the post portion of the terminal.

(2) Excessive solder used in tinning; the wire strands not visible, not able to see any damage that may exist under the tinned surface. (nicks or scrapes)

INSTRUCTOR ACTIVITY

e. Display slide YXH  
L8-S19

f. Display slide YXH  
L8-S20

STUDENT ACTIVITY

433

803

804

in mathematics, although the majority felt adequately prepared. The technicians desired to have the courses structured, using electronic principles, and to have the electronics technology department teach the mathematics.

The studies by Killin and Reburn illustrated a problem. High school students receiving college preparation mathematics achieved higher scores in college math and science than did students with vocational education preparation. The questions that arise are these: Should persons in high school desiring technical education in college be encouraged not to enter a vocational program? With the advancement of technology and the competitiveness in school, must a high school student have advanced mathematics in order to survive in a postsecondary technical program? Is job satisfaction more important than making better grades in math and science? Reburn found that students wanted the electronics department to teach the mathematics. Questions to be considered are: Will persons in the electronics - or in any technical department - want to teach mathematics? Will mathematics deteriorate in quality if taught by persons outside the mathematics department?

#### COMPUTER INSTRUCTION

The use of computer instruction is cited throughout the research literature, especially in the military and individualized instruction studies. Rasmussen (1975) reported surveying Texas community college instructors on their conceptualizations of future teaching roles involving computers as components of instruction. His field survey instrument was submitted to a stratified random sample of computer instructors categorized as nonexperienced, experienced, and specialists. The analysis of differences among the groups regarding beliefs concerning computer instruction, dehumanizing effects, the reduction of teacher status, and the permanence of computers in education revealed no significant differences. Each believed computers would improve education without dominating the educational process.

Tholl (1973) developed a computer-managed instruction (CMI) system for a course in the principles of electronics at Cerritos College in California. The system, using forty-three students enrolled in the course, was tested for seven weeks. Evaluation was based on student beliefs concerning educational responsibility, student progress, student reactions, and staff reactions. His findings indicated that students varied greatly in the time necessary to attain mastery. Students who believed they learned



OUTLINE OF INSTRUCTION

2. Wire position

- a. Proper position of the wire on the terminal requires that it be set firmly against the post portion of the terminal and ~~that it be set flat~~ on the pad area as viewed both from the front and the side.
- b. Wire holding devices may be used to hold the wire in position and to prevent motion while soldering.
- c. Proper positioning of double wires on a turret terminal.

INSTRUCTOR ACTIVITY

- a. Display slide YXH L8-S21
- c. Display slide YXH L8-S22

STUDENT ACTIVITY

hch

vocational-technical teachers in forty public community colleges in Texas. The report contained a review of research on competency-based teacher education which was used to design the research study. An explanation of approaches to developing curriculum for teacher education also was included. Four of the main findings related to technical education were as follows: (1) All ninety-four tasks on the questionnaire were performed by some respondents from each of the vocational areas of office occupations, technical occupations, and industrial occupations. (2) More respondents in the area of technical occupations than from any other vocational area in the study were involved in acquiring occupational skills. (3) The respondents in technical occupations performed twenty-three tasks (of the ninety-four given) which consumed an average of 50 percent of their time. Of these twenty-three fifteen were in the function of instruction. (4) The placing of students on the job was performed by 11 percent of the respondents of technical occupations. This research was based on mean ranks without statistical analyses of the data. In addition, the actual performance was based on the respondent giving an estimate of time taken to perform a particular task. This may be a flaw in measuring actual performance.

In order to upgrade an associate degree program called Municipal Engineering Technician offered at the Southwest Wisconsin Vocational-Technical Institution, Stegeman et al. (1975) studied the basic entry competencies required by water utility operators. The program was developed to meet the demanding needs of towns, villages, and smaller cities who needed to employ people with diversified technical backgrounds. The research findings were grouped into four principal topics: utility characteristics, operator characteristics, operator competencies, and training requests. The survey was limited to individuals employed by generally small utilities using ground water as a source.

Borcher and Joyner (1973) conducted a task inventory analysis survey for designing and revising two-year associate degree programs in secretarial science technology. The task analysis was based on an instrument designed from a review of the literature and a critique by five experts employed in secretarial occupations. The occupations studied were general, legal, and medical secretaries; office managers; and executive and administrative assistants. The sample was selected from those working in the metropolitan area of Columbus, Ohio who were members of the National Secretaries Association. The total number of usable responses was ninety-nine (57 percent return). Forty-eight percent of the respondents were executive secretaries, 23 percent were general secretaries, 19 percent were administrative assistants, 6.1 percent were legal secretaries,

OUTLINE OF INSTRUCTION

d. Wire positioning requirements are the same for two or more wires as they are for single wire connection with the following additional requirements:

- (1) All wires are wrapped in the same direction.
- (2) All wires are trimmed to the same lengths.
- (3) Wires are positioned directly one above the other.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

425

807

803

engineering/electrical technology. The objectives were to identify other institutions involved in such projects, to identify performance goals and systems for each program/department, to translate each course into performance-based criteria, and to implement a feedback system to evaluate this process. The processes used in this study should be useful to administrators and staff development officers in community colleges.

#### INDIVIDUALIZED INSTRUCTION

Horne (1977) conducted an experimental study in which he tested students using an individualized instructional systems approach in a drafting course at the college level. He also studied the effects of individualized instruction on academic ability (high and low) and community college type (urban and suburban-rural). The sample consisted of ninety-nine students in four community colleges in Virginia. Students at each college were randomly assigned to the two treatment groups. One instructor taught both treatment groups at each college. A teacher-constructed drafting achievement test was administered as both a pre- and post-test. An instructional attitude inventory also was administered at the end of the course. The educational ability of each student was measured by the SRA Short Test of Educational Ability. Horne found that the individualized groups scored significantly (.05 level) higher on the post-test than the traditional groups. There was no interaction between treatment method and student ability. The urban community college students scored higher than did the suburban-rural students. There was no difference in student attitudes toward either treatment method. Horne concluded that the individualized systems approach was superior for teaching technical drafting.

As a result of several instructional/cost problems, Harris and Rodgers (1975) conducted a study of the Lincoln Laboratory LTS-3S training system to teach mining skills. The LTS-3S is a mechanical device utilizing multimedia and microprocessor (computer) techniques to assist the instructor in teaching. Prior to this study, the LTS-3S had been tested and found successful by the United States Air Force in a six-week basic electronics course using fifty-five subjects. The area of basic electronics safety as taught in the mine maintenance course was the focus of their study. While Harris and Rodgers reported positive results using the LTS-3S, there appeared to be little data to support such conclusions. The research was done for the Bureau of Mines in the Department of the Interior.

### OUTLINE OF INSTRUCTION

- e. Improper positioning of the wire in that a pair of pliers is being used to squeeze wire against post portion of terminal. This will cause the wire to fit improperly against the post and may damage the wire as follows.

(1) Smashing of the strands

(2) Disrupting the tinning inside the wire.

(3) Nicking or cutting of the wire strands.

809

### INSTRUCTOR ACTIVITY

- e. Display slide YXH  
L8-S23

### STUDENT ACTIVITY

810

426

These coordinators were categorized as (1) beginning, (2) experienced, and (3) outstanding. Analysis of variance and factor analysis were used. Based upon these analyses, Post designed a behavioral model for coordinating cooperative technical education programs.

Kalugin (1975) studied two-year college level cooperative education coordinator work loads and activities. Six hypotheses were tested to determine significant differences between the coordinators' functioning and the location of the college (e.g., rural or urban), the number of assigned students, the number of work stations, the assigned work schedule, prior work experience, and the length of teaching contract. One hundred and six coordinators from twenty-four states responded to a questionnaire containing forty activities and eight background statements. The data were analyzed by the chi square test of independence. The most important findings were that coordinators from urban colleges devoted more time to individualized guidance sessions than did those coordinators in suburban and rural locations; those with greater student loads spent more time in coordination and management activities; those with assigned work schedules of more than eighteen hours per week and twelve-month contracts did more in the areas of public relations and guidance.

Boardman and Mendenhall (1975) conducted a comprehensive study for planning cooperative education for the Mid-Plains Nebraska Technical Community College area. To accomplish this objective, they assessed the vocational interests of students in grades nine through twelve, assessed employer demands, and visited the majority of Nebraska's two-year postsecondary institutions with cooperative education programs. The Ohio Vocational Interest Survey and Minnesota Work Values Inventory were used to assess the interests of 927 students, a mailed survey of 827 employer responses was analyzed for demand. The findings were that student interest was in farming-fishing-forestry, while employer demand was in the category of services. They concluded that cooperative programs need to be planned in the service areas, especially for food and beverage preparation, lodging, and related services (including institutional and home management); personal services (such as nursing assistants, medical technicians, physical therapists, home health aides, and specialists in guidance of children); and agriculture supplies/services.

Smiley and Budke (1973) developed a bibliography of abstracts to assist program planners and administrators in locating pertinent data on postsecondary cooperative education programs. Some of the items had a research basis but most did not. Entries included two-year postsecondary cooperative education programs

OUTLINE OF INSTRUCTION

f. One method of securing the wire prior to soldering.

g. In field operations any method that will hold the wire may be used such as the use of rubber bands, clips, etc.

3. Area to be soldered

a. The area to be soldered consists of the pad portion of the terminal, the post portion of the terminal, and the area of the wire in contact with the terminal.

811

INSTRUCTOR ACTIVITY

f. Display slide YXH.  
L8-S24

3. Display slide  
YXH L8-S25

STUDENT ACTIVITY

427

812

almost precludes the publishing of curriculum guides. Technology changes so rapidly in some fields that many publishing companies have changed to three-ring binders. The companies issue, on a subscription basis, new instructional units to replace outmoded ones.

#### TEXTBOOK REQUIREMENTS

Reshier (1974) gathered data from a stratified random sample of electronics communications instructors across the nation in order to determine the adequacy of currently available textbooks for associate degree level electronics communication courses. A survey was used to sample twenty instructors each in ECPD accredited programs and non-ECPD accredited programs. All ECPD instructors replied; however, only fifteen of the non-ECPD persons responded. The questions covered such items as suitability of existing texts, theory, practical applications, major concepts, and frequency of changing of textbooks. The findings were compared to what the investigator expected, so that his opinions/bias could be compared to the actual results. The study can provide a guide for an instructor doing his or her own study in this area.

#### TECHNOLOGY DEGREES

The Engineering Joint Council (1975) conducted a national survey of engineering and technology degrees, as reported to the Engineering Manpower Commission of Engineers Joint Council for the school year ending 1974. The technology degree tables included data from 423 schools, including all ninety-seven on the Engineering Commission for Professional Development (ECPD) list for 1973. Of the group, 378 reported two-year degrees (twenty of these had only pre-engineering transfer programs) and ninety-three reported bachelor of technology degrees (forty-five of these had only four-year programs).

#### RESIDENTIAL CENTERS

The Maryland State Advisory Council on Vocational Education employed McManis Associates, Inc. (1975) to conduct a study designed, in part, to determine unmet vocational and technical education needs which might be met by residential education. A second part of the study was designed to study the alternatives to meet the discovered needs. From this research report, technical educators can learn the complexity of integrating programs to solve



OUTLINE OF INSTRUCTION

- b. Where cutting the bent wire leaves copper exposed, the soldering operation must ensure that no copper remains exposed.

4. Solder quantity

- a. Solder quantity shall be such that all angles formed by the junction of the wire and the terminal will be filled with solder to form a fillet.
- b Overall flow of solder shall present an appearance of concave fillets extending approximately one half the distance across the wire.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

813

814

428

## STUDENT NEEDS AND CHARACTERISTICS

Research pertaining to the interests of students includes a number of studies dealing with both needs and characteristics. In addition to the initial section on characteristics, the studies reviewed below included reports on follow-up studies, needs assessment and other methodologies for determining needs, handicapped students, enrollments and barriers to enrollments, attrition, and mobility.

### STUDENT CHARACTERISTICS

Hartz et al. (1978) reported the results from a project designed to develop empirical models and standards for employability relative to the personal/social skills needed for employment acquisition and retention. Data were collected from former and current students of two Wisconsin postsecondary vocational-technical institutions. Of these students, 455 were technical. Former students were from 1975-76 and 1976-77; current students were those scheduled to graduate in June 1978. The data were collected by the use of an instrument specifically developed in another phase of the study. This instrument, the Employability Inventory, contained seventy-seven items designed to assess the personal/social skills important for job getting and keeping. The instrument was pilot tested using 400 respondents. The Kuder-Richardson formula was used to determine stability of responses. A .76 coefficient of reliability was obtained on Form A and .77 on Form B. The major purpose of the study was to attempt to validate empirically items in the inventory by testing whether or not these discriminated between groups on employment status. It was assumed that if the characteristics and skills identified were critical, and if the seventy-seven items were well designed, responses by the employed, unemployed, and underemployed should differ. Additional analyses were made concerning sex, work experience, program area completed, and locale of training. The chi square test of independence revealed very few items that discriminated between employed, unemployed, underemployed, and the other variables. Based on the few items which differentiated between former and present students, the researcher concluded that the groups did not differ in the skills and characteristics measured. However,

OUTLINE OF INSTRUCTION

- c. Contour of the wire strands shall be visible.
- d. There shall be no convex appearance to the solder flow on the finished terminal.

E. Techniques for Making High Quality Turret Terminal Solder Connections

1. Application of flux

- a. Flux cored solder normally supplies all necessary flux for proper wetting of solder.

815

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

429  
624

816

the equally rapid growth of programs for paraprofessionals, particularly those dealing in human services. The purpose of his study was to measure the self-perceptions of students in a two-year mental health technology program at the Manhattan Community College in New York. His subjects were thirty full-time, day students. They were tested for self-perception, ideal self-perception, and level of occupational interest before and near completion of the first year of study. The Bills Index of Adjustment and Values and the Occupational Interest Inventory were used. T-tests, chi square, and product moment correlation were applied to the data. Farber found the students tended to develop more realistic self-perceptions and had initial high occupational aspirations which did not change.

Garbin and Vaughn (1971) studied the characteristics, experiences, and perceptions of community-junior college students enrolled in occupational programs. The primary sources of data were approximately 5,000 students in vocational-technical programs at sixty public, community-junior colleges. Their main conclusions were that half of the nation's labor force should have two years of postsecondary education and that the need for significantly greater numbers of graduates of such education was evident. The development of postsecondary occupational education in the community college has developed and the public as a whole has had limited exposure to the entrance requirements, programs, and opportunities for graduates. Therefore, advertising to educate the public should be initiated. Increased funding will enhance availability of programs, lessen personnel shortages, and show tangible evidence of government commitment. Most high school students, parents, and - not infrequently - school personnel ascribed lower status to post-high school occupational education. Although the prestige of professional jobs has remained stable, the money, benefits, and working conditions of technical occupations has increased. Their study showed that the general public views the quality of students in community colleges and the quality of the programs as inferior to baccalaureate students and programs. According to their statements, these myths of inferiority must be eradicated. Their study showed that students who make an occupational commitment in mid-high school have greater persistence and graduation rates.

Webb (1971) developed a comparative profile to determine differences among day-time and evening enrollees in electronics technology courses in community colleges in San Jose, California. His survey was based on 853 responses from six colleges. He found significant differences (.01 level) on thirteen factors including ease in finding employment and employment history. Agreement was found on six factors, including hobby patterns and

### OUTLINE OF INSTRUCTION

- b. External flux may be used; however, the possibility of causing the solder to wick under the insulation increases greatly.

### 2. Proper heat

- a. Proper heating is required to bring the terminal and wire mass RAPIDLY to the melting temperature of solder.
- b. Proper heating is accomplished by using the appropriate size tip and the appropriate wattage element for the size of mass involved.

817

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

3-1-37

818

430

which would provide opportunities for developing social skills of a formal nature (as well as providing activities of a warm, friendly nature) than did community college respondents. The variance, however, between these two groups was small; thus, there is a serious question about the extent these findings have educational significance. Kievit also found that the personality profiles of dropouts from the technical institute were the same as those who continued at the community college on the factors of intellectual interests and motivation. This finding causes one to question whether the technical school dropouts would have continued had they been enrolled in a community college. The same question can be posed for dropouts from the community college because mean scores on intellectual interests and motivation were almost equivalent to those students who continued at the technical institute.

Rothwell (1970) attempted to determine if success on selected tests was a predictive measure of job success when participants were evaluated by the employer using the Minnesota Satisfaction Scales as a method of measuring job performance. The selected tests were the Visual Speed and Accuracy Test (Form A), the National Business Entrance Stenographic Test (Form 20-56), and certain personality traits measured by the sixteen P.F. personality Tests (Forms A and B). This study involved 300 students in Alabama state technical institutes and junior colleges. The students were tested prior to graduation and evaluated by their employers six months after graduation. Rothwell found that those who had significantly high job success, as evaluated by their employers, scored significantly higher on the factors of intelligence, emotional stability, and "tendermindedness" in the sixteen P.F. Personality Tests and the National Business Entrance Stenographic Test.

Cross (1970) reviewed the research concerning students enrolled in occupational programs in community colleges. She indicated that the narrow definition of academic occupational education had not been considered "respectable" and that students in occupational education were regarded as less than "talented." However, she noted that higher education must change, because education is the key to a person's work in a technological environment. Although the research Cross examined was minimal, nevertheless, she described some characteristics of the occupationally oriented student. For example, 43 percent in technical programs hoped to transfer to a four-year college. The average academic ability was lower than in four-year college students; most students fell in the middle range ability with few in the lower or higher ability ranges. Men in occupational curricula scored significantly lower than those in college-parallel programs but women's scores were similar. Women in health occupations scored higher than those in the liberal arts. In

### OUTLINE OF INSTRUCTION

- c. A solder bridge accomplished rapid transfer of heat from the iron tip to the connection.

### 3. . Application of solder

- a. For proper application of solder, bring a clean, dry iron into contact with BOTH the terminal and the lead.
- b. Properly positioned the iron to contact both the terminal and the lead, and a heat bridge being established between the iron and the lead with CLEAN solder.

### INSTRUCTOR ACTIVITY

- b. Display slide  
YXH L8-S27

### STUDENT ACTIVITY

431

0211

819

3-1-38

obtained their present job without this education, and most were highly satisfied with their present occupations.

Lach (1978) reported the second year results of a three-year follow-up of Illinois public community college occupational students. Thirty-eight colleges enrolling a total of 27,663 first-time students (fall, 1974) comprised the population and sample. Of these students, 12,512 were full-time and 15,151 were part-time. Female students constituted 50.3 percent of the population. Highlights of the findings were as follows: only 56.2 percent of all occupational students enrolled at a college intended to prepare for employment in that career area. Many students entered college with short-term objectives and could complete their objectives by enrolling in a few courses. Only 2.9 percent of those students who graduated during the second year of the study were unemployed or seeking a job. Placement rates for these students were higher than in bachelor's degree programs: 25.9 percent of former students were continuing their education, 81 percent of the graduates reported satisfaction with their program, and 66 percent of the students took jobs in the college district which they attended. Lach concluded that the occupational/career programs in the public community colleges in Illinois were very effective in meeting the needs of a wide variety of students.

The Engineering Manpower Commission of Engineers' Joint Council (1977) surveyed 45,275 engineering and technology graduates from schools across the country. The Commission found that the demand for associate degree and bachelor degree graduates was the highest since 1969. Persons with master's degrees and doctorates seemed to be in more demand than people with two- and four-year-level degrees. Starting salaries continued to move upward in 1977, varying from 11.3 percent for associate level technology students to 5.1 percent for doctoral level. Women engineering students, who were 5 percent of the graduates, continued to receive higher salary offers than males. The highest monthly salary for graduates of ECPD accredited programs was in automotive technology (two-year level) at \$1096; the lowest was architectural at \$935.

Stoehr et al. (1976 b) studied the relationship between data processing competencies taught in the Wisconsin Vocational-Technical, Adult Education District data processing programs and on-the-job demands as a basis for curriculum revision. A sample of 152 graduates, eighty employers, and fifteen instructors reacted to an instrument adapted from an instrument by Kettner which contained seventy-five competencies. Rank correlations between importance, frequency, performance, and future need among the graduates, employers, and instructors were all extremely high (.01 level of significance), indicating agreement



OUTLINE OF INSTRUCTION

c. Solder being applied to form a fillet.

(1) At this time, place the solder at the end of the wire to tin the exposed copper and also form the fillet between the end of the wire and terminal, as well as the fillet between the start of the wire bend and the terminal where the wire enters the connection.

(2) This fillet is formed by wiping the solder across the end of the wire and continuing across the pad portion of the terminal and into the angle formed by the incoming wire and the post.

INSTRUCTOR ACTIVITY

c. Display slide YXH  
L8-S28

STUDENT ACTIVITY

821

822

Lansing Community College (Michigan), the Community College at Denver (Colorado), and Longview Community College (Missouri). A follow-up study was conducted to evaluate the impact of the program on the students' job performance. Data were obtained on eighty-one graduates. Of these, twenty-nine were employed as transportation engineering technicians, twenty were employed in similar highway fields, and seven were working directly in highway safety. Their supervisors indicated a generally restricted job market for TETs. They also indicated the graduates required less on-the-job training than other employees and that communicative skills should be stressed. Students felt a baccalaureate degree was needed for advancement. They had not received any significant salary increase as a result of the program. However, the majority of the students were satisfied with the program and felt their job ability was improved.

Morris and Gold (1974) described the Student Accountability Model developed by a consortium of twelve California community colleges in order to provide short-range follow-up of community college occupational students. The description and model were thorough and well-conceived, with complete illustrations of the model reported.

Tari and Maiers (1974) conducted an evaluative study of the Madison Area Technical College architectural technology programs by surveying the college graduates for years 1969 to 1973 (inclusively) and the employers of these graduates. A 30 percent usable return of employers (N=39) was obtained. Twenty-eight percent (107) of the students replied. The three questions for the study were (1) Are the present programs meeting the requirements of employers and graduates? (2) What are the needed program changes? (3) What are the present and future employment needs in architectural technology? The instruments were based on face validity only. The discussion of why graduates answered the needs questionnaire in certain ways was interesting. For example, some students checked an item as knowledge essential and later indicated they have little use for the item (knowledge or skill) on their job. Also, the report showed that employers varied immensely in what they expected of graduates. This points out the complexity of duties and competencies expected of technicians in this area. For example, "We feel that there is too much emphasis on the architectural design area. The conceptual design almost 100 percent is done by architects and engineers in our office. We expect the technicians to be more versatile in detail work and good drafting techniques" (p. 14). Generally, however, the employers were satisfied with the programs. The graduates wanted more course work in architecture and fewer related courses. They expressed concern with a lack of practical relationship between the courses offered in general studies and the technology area. The graduates expressed satisfaction with

### OUTLINE OF INSTRUCTION

- (3) When the proper amount of solder has been applied, remove the solder and the iron at the SAME time. This will prevent overheating of the solder and result in a smooth, gleaming finish.

#### 4. Cleaning after soldering

- a. After the solder connection has cooled and the solder has solidified, the connection must be thoroughly cleaned with an approved solvent to remove all traces of flux.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

433

823

823

50 percent of their students in occupational programs. In contrast, the students in private schools were almost entirely trained for occupations. Another major difference was unemployment. University campus graduates had the lowest rate (median 6.1 percent). Community colleges experienced a 7.1 percent median, and private schools had an unemployment rate almost double that of the other two institutions. They also reported that the least successful programs in terms of graduates' ability to obtain jobs related to their college major were forestry technology, business administration/management, apparel and accessories, and marketing/retail/finance programs. The researchers concluded that the results for these four programs indicated planning of these programs may not be based on available labor market information.

Maner (1972) studied the relationship between quantitative measures of mathematics, electronics, physical science, and total credits required for graduation and the dependent variables of beginning salary, salary after five years, and job success. Graduates for 1967 from thirty-one community colleges were selected for the survey. Twelve of the colleges had associate degree electronics programs accredited by the Engineers' Council for Professional Development (ECPD). The remaining programs were not accredited. Twenty-four of the institutions cooperated, and 260 graduates (57 percent return) furnished usable surveys. The data analysis included a bivariate analysis where T-tests of means were used to determine the success of accredited and nonaccredited programs. A correlation analysis for salary and independent variables was conducted. Multiple regression and analysis of covariance were used to determine predictive effects of curriculum factors on salary. Maner reported that graduates from accredited programs were more likely to have higher salaries, be more mobile, take their first jobs in areas directly related to their education, and hold education-related jobs five years after graduation. Graduates of the nonaccredited programs were more likely to remain with the same employer for a longer time. There was no significant difference between graduates of accredited and nonaccredited programs concerning salary after five years, ability to obtain the first job, job satisfaction, employment security, or salary progression during the five-year period. It also was found that no significant relationship existed between the beginning salary and ending salary and credits earned. In addition, the "standards" of the ECPD and American Society for Engineering Education were not valid predictors of job success.

Harris (1972) reported that, in the follow-up of the Portland Community College graduates (766 students, of whom 69 percent

OUTLINE OF INSTRUCTION

- b. A bristle brush and solvent being used to remove all traces of flux and any foreign matter tha may remain on the terminal.

F. Inspecting Completed Turret Terminal Solder Connections for Quality

1. Standards of acceptance

- a. Wire being used to gauge the insulation clearance.

825

INSTRUCTOR ACTIVITY

- b. Display slide YXH.  
L8-S29

- a. Display slide YXH  
L8-S30

3-1-41

STUDENT ACTIVITY

826

434

by the California Community College Board of Governors that all community college districts refrain from implementing any new programs for marine technicians until all existing programs could be evaluated. Some of their findings were that (1) marine technology instructors have fallen behind in their perceptions of the skills required by marine technicians and those skills found to be necessary in actual job situations, (2) the term "marine technician" was not understood by industry, and (3) students need to be told of job scarcity.

Watkins et al. (1973) assessed the need for chemical technicians in seventy-five industrial organizations in Alabama, as well as the kinds and types of skills required by major employers. His major finding was that advancement of science caused the professional chemist to move into research providing excellent employment opportunities for chemical technicians. These opportunities existed largely in the petroleum, air pollution, water treatment, food, drug, chemical, soap, rubber, paint, textile, power, steel, aluminum, and plastics industries.

Perhaps these two studies could have been included under the topic of manpower; however, it appeared appropriate to have some examples of needs surveys/assessment under this category. Heinket and Tepedino's study was chosen because they interpreted the data, a procedure not carried out in many studies. Their findings were not favorable, that is, the instructors were dated in their knowledge and perceptions, and there was a job scarcity. Watkins' study was chosen because he detected a major movement in a field - that the professional chemist was found be moving into research, and that left a place for new jobs. Needs surveys/assessments must be sensitive enough to discover facts such as these and to report the findings - favorable or unfavorable - to institutions, programs, or individuals.

Fishkind (1976) produced a methodology for determining needs for vocational and technical education for the Florida State Advisory Council on Vocational and Technical Education. Unique results were claimed by the researcher in three areas. First the report showed how existing manpower techniques for an urban labor market area can be improved, expanded, and made more meaningful for VTE planning. Second, a systematic and comprehensive procedure was developed to project the future supply of labor by occupation. Third, a format was developed to relate occupational supply and demand forecasts to VTE program codes in a more easily understandable and usable form. His report contained a review and analysis of the major concepts, definitions, and research concerning needs assessments, manpower data, costs, and benefits. This was, actually, more meaningful than the results of the use of the developed methodology.

### OUTLINE OF INSTRUCTION

- b. Insulation gap shall be no greater than a distance equal to two times the overall diameter of the wire, including the insulation, measured from the insulation to the edge of the solder flow on the terminal
- c. The preferred insulation clearance for turret terminals is one overall wire diameter,
- d. Wire shall be confined to the guide slots.
- e. Wire shall be flat on the pad portion of the terminal.

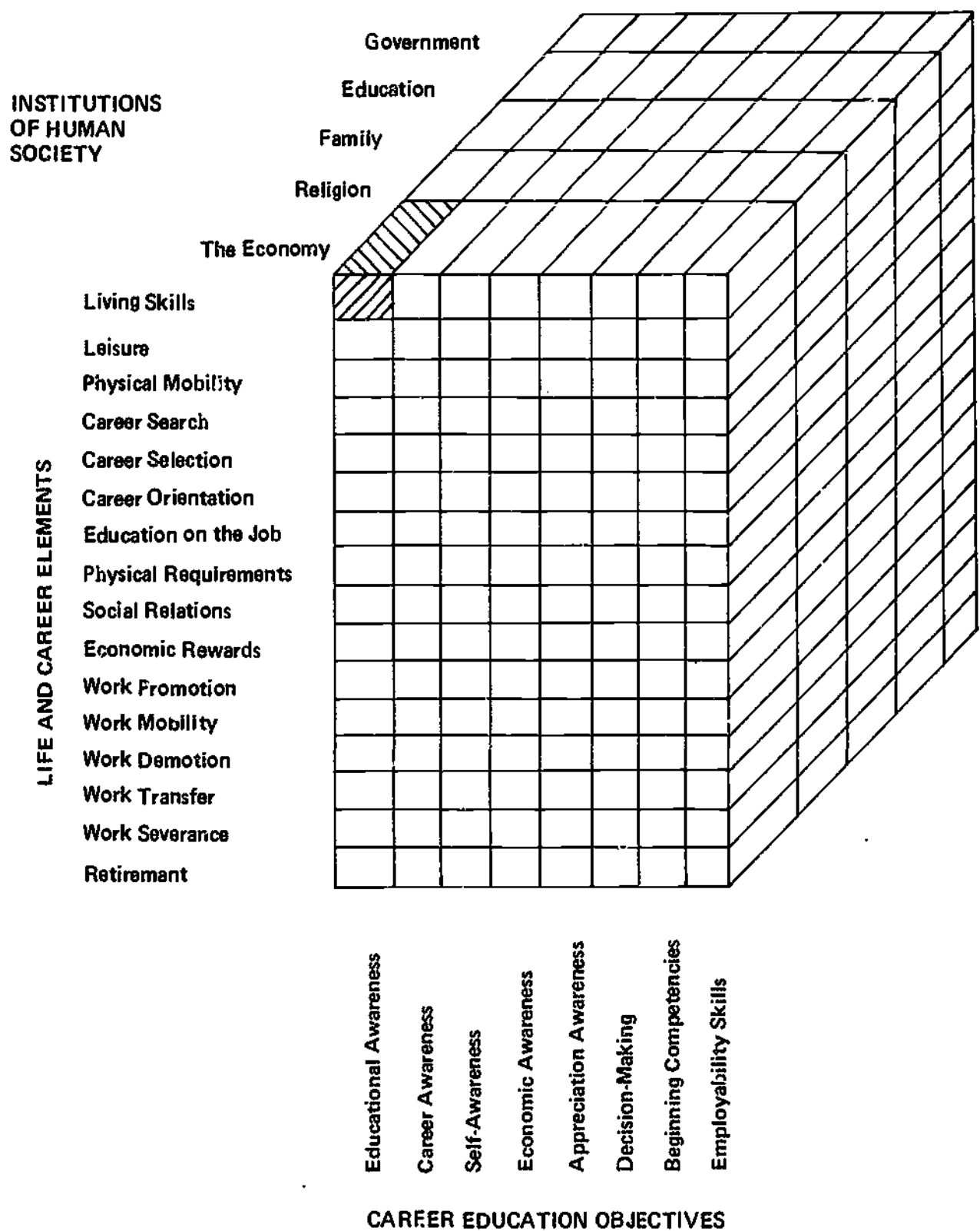
### INSTRUCTOR ACTIVITY

- b. Explain all standards of acceptance.

### STUDENT ACTIVITY

435

Figure 1: The Essential Areas of Research



Source: Doty and Isaac, 1975.



OUTLINE OF INSTRUCTION

- f. Bend of wire shall fit snugly against post.
- g. Solder shall have a smooth gleaming finish free from holes, pits, and stress lines.
- h. Solder shall show no evidence of dewetting from the terminal or the lead.
- i. The contour of the wire strands shall be visible and the solder flow shall present concave fillets.

829

INSTRUCTOR ACTIVITY

3-1-43

STUDENT ACTIVITY

830

436

## BARRIERS TO ENROLLMENT

Manrov (1977) investigated sex bias in postsecondary occupational educators in USOE Region Three, (Delaware, Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia). The purposes of the study were to identify and compare the views of male and female occupational educators in the following areas: those teaching in male-oriented, non-sex-oriented, and female-oriented programs; and those teaching in small, medium, and large campuses. A survey instrument was developed, validated, and post-tested. It contained thirty items for use with a random sample of 417 educators. A 63.3 percent response was obtained. Pearson product moment correlation coefficients were used to test relationships of biographical variables to sex bias scales. MANOVA was performed to determine if differences existed between sex bias scores and the educator subgroups. Manrov concluded that sex bias existed among male and female postsecondary occupational educators. The sex of the educators had an effect upon their sex bias and general sex bias beliefs, with males tending to show more sex bias. Also, the greater the years of teaching experience, the greater the opposite sex bias and general sex bias. General sex bias indicated the reluctance of educators to accept coeducational classes in occupational programs and to support strategies for eliminating sex stereotyping. Some sex/opposite sex bias indicated the tendency to cling to sex stereotype notions of male and female school-related abilities.

Jaeger (1976) identified barriers which appeared to deter potential students from enrolling in and attending vocational-technical postsecondary programs. A survey, consisting of a twenty-one-item instrument, was conducted from which a 40 percent return (1092 persons) of potential students in four districts in Wisconsin responded. Of these, 655 were potential post-high school students who it might be assumed would enter technical curriculums. Their reasons for not entering post-high school education, in priority order, were (1) postponed plans, (2) could not decide, (3) found a permanent job, (4) needed to earn money for self support and family, (5) local programs did not offer desired training, and (6) accepted at another school. One fifth of the respondents lacked financial aid. Of this group, 24 percent did not know if any aid was available, and 14 percent said that there was no aid available. Transportation was a problem for 13 percent of the persons, both urban and rural. Of the 8 percent who indicated that lack of information was a barrier, one-fifth did

OUTLINE OF INSTRUCTION

- j. Insulation shall show no signs of overheating such as swelling or discoloration nor shall it be imbedded in the solder joint.
- k. There shall be no wicking of the solder under the insulation. This provides the required flexibility at the connection to prevent vibration and stresses from causing the wire to break at this point.
- l. There shall be no spillage of solder over the sides of the terminal (a thin wetted area is acceptable).

831

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

437

432

## ATTRITION

Michlein et al. (1976) studied student attrition in four Wisconsin technical institutions. The objectives of his study were fourfold: to identify the extent of student attrition by such categories as "job outs," transfers, failures, or socioeconomic withdrawal, to identify background characteristics, ability factors, and self-concepts which predict student attrition; to analyze background characteristics, ability factors, and self-concepts to determine their effect on student attrition; and to determine program deficiencies, if any, and recommendations for change. His review of the literature mainly concerned aspects of student attrition: dropouts, "dropins," "jobbing out," nonpersisters and the like. In addition, a separate report on the research for each technical institute was included. Some of Michlein's conclusions, based on a follow-up of 2007 dropouts, were that (1) uniform information on students was lacking, and there was difficulty in handling what existed; (2) no one act that will stop attrition was identified; (3) there were as many reasons for attrition as there were dropouts; (4) a large percentage of dropouts did not remain due to lack of motivation or commitment (according to Michlein, this is the group that must be served). He proposed that one person per institution should be assigned the responsibility of follow-up of dropouts.

## MOBILITY

Buzzell (1971) assessed the degree to which mobility - geographic and occupational - was a function of the type of institution in which the certified electronic technician was educated, that is, high school, post-high school, or on-the-job. A questionnaire was used to survey the entire population (1,563) of certified electrical engineering technicians in New Jersey, New York, and Pennsylvania. A 56.3 percent response was obtained. Buzzell found that there was no significant difference in either geographic or occupational mobility among the three groups of technicians.

Mobility of students and workers appears to be a worsening problem for educators and industry. As reported in the U.S. News and World Report ("World Business," 1978) workers will not commute; they find it more profitable to remain idle because jobless benefits are generous. Therefore, they do not have to move where the jobs are.

OUTLINE OF INSTRUCTION

2. Indications to look for

a. Inspection of a turret terminal for quality involves all of the standards of acceptance.

b. Two views of a completed turret terminal.

(1) As we inspect this terminal, we can see that the contours of the wire strands are visible; there is also a smooth fillet between the terminal and wire.

INSTRUCTOR ACTIVITY

b. Display slide YXH  
L8-S31

STUDENT ACTIVITY

meeting with consultants, attending state-level professional education association meetings, and meeting with instructors from four-year colleges for accomplishing program development and articulation. Kolendrianos reported the three most popular opinions of instructors in regard to inservice needs were that the instructor should have a selection of activities that will strengthen professional competence, that special orientation activities for new staff be provided, and that credit be given for participation in inservice activities. In addition, the main point expressed by instructors and administrators was that focus be given to new developments in one's specialty, preparing instructional materials, and techniques to maintain student retention.

Geigle (1977) developed and tested a procedure for assessing the pedagogical needs of postsecondary vocational and technical teachers. His pedagogical needs assessment system contains three instruments which include 100 competencies. To test the reliability, validity, and utility of the system, 200 teachers, their supervisors, and their 3,000 students from four Minnesota area vocational-technical institutes did self-ratings and ratings of the teachers, respectively. The internal consistency of the teacher, supervisor, and student instruments indicated high internal consistency reliability. Using the Pearson correlation for test-retest over a two-week period, Geigle found the teacher and supervisor instruments had high stability correlation coefficients, while the student instrument had lower (but acceptable) stability. Validity tests, e.g., profile analysis and Pearson correlation, revealed a higher similarity between the teacher self-ratings and the supervisor ratings and less agreement with the student ratings. Geigle concluded from the evidence on validity that instrument concurrent validity was indicated but had limited construct validity. The perceptions of the participants indicated the system was useful, at least for the four institutes.

Storm (1976) conducted a nationwide survey that indicated widespread and nearly unanimous interest in technical upgrading of postsecondary professional personnel. He reported that, in spite of this positive interest, few postsecondary institutions have inservice programs that satisfactorily serve the technical upgrading needs of their respective instructors and administrators. He also reported that postsecondary institutions in almost 50 percent of the states were exempt from teacher certification requirements; and even in states where they were applicable, the requirements were frequently fulfilled through advanced education, administration, or supervision courses and workshops which did not fulfill the objective of technical upgrading. Storm's study and corresponding

OUTLINE OF INSTRUCTION

- (2) There is no trace of flux or copper showing at the end of the wire, and also the base of the terminal is tinned as it should be.

3. Reasons for rejection

- a. Many reasons exist for rejection of a turret terminal connection.

- b. An unreliable, rejected connection.

- (1) Broken wire strands.

INSTRUCTOR ACTIVITY

- b. Display slide  
YXH L8-S32

STUDENT ACTIVITY

439

836

835

A stratified random sample of 375 teachers produced a 77.6 percent return (290). Bloom reported the most widely used activities were reading occupational and professional education journals, meeting with other occupational instructors formally and informally, observing employees in their occupational area, and formal staff meetings. Inservice activities least used were both long- and short-term institutes or workshops, national association meetings, and research. Bloom found that sex, hours of work per week, the number of years of work experience, size of campus, distance from a college or university, age, or recency of a teacher's participation in preservice education made no difference in occupational teachers participating in professional growth activities. On the other hand, the higher the level of education, the more years of teaching experience, and the teacher's perception that administration supports inservice education did influence teachers to participate.

Sugarman (1973) conducted an Education Professions Development Act workshop (EPDA) in order to examine certain aspects of teaching technical education. The report contains two sections: the first included twelve papers on technical teaching on such topics as disadvantaged college students, adult learning, individualized instruction, evaluation, and administration; the second contained a model for technical teacher education.

Schmitt (1971) focused upon the problems of the adjunct technical instructors in Michigan community colleges. He identified the problems of adjunct and full-time instructors as perceived by themselves, their supervisors, and their students. His sample consisted of eleven of the sixteen community colleges in Michigan. Two adjunct instructors, two full-time instructors, their supervisors, and students were interviewed in each college. In addition, the students completed a rating form. Multivariate analyses of variance were used to identify problem differences between the two types of instructors. Pearson product-moment correlation tests were used to detect any relationships between instructor self-ratings and student ratings. Schmitt indicated that the supervisors identified the problems of adjunct instructors as follows: selecting and organizing course content; grading and evaluating students; developing test materials; and problems in selecting, designing, and using teaching aids. Adjunct instructors expressed concern with the lack of course outlines and faculty guidelines from the colleges, self-evaluation, individualizing instruction, identifying priority competencies needed by students for an occupational area, keeping current, and developing tests. Analysis of student ratings revealed that course content of the full-time instructors was viewed as better organized. While not statistically significant, full-time instructors were rated by the students



OUTLINE OF INSTRUCTION

(2) Discolored insulation.

(3) Wire not properly positioned on terminal.

(4) Overheated solder.

(5) Disturbed solder

(6). Wicking

(7) Scrapped spot on the terminal

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

837

3-1-47

838

Ohh

There were significant gains in the degree of accomplishment ratings of teaching performance on oral questioning for the fellow instructor review group and the teacher educator review group. It should be noted, however, that - because of the reluctance of people to change, be observed and critiqued - implementation of such techniques involves patience.

Technical teacher education has not enjoyed the attention it deserves. The reason, of course, is that the employing institution would prefer a candidate with industrial experience rather than relying on teaching experience to provide competency in pedagogy. This reliance on teaching experience has not provided the best means to achieve proficiency. The 100 modules produced by the National Center for Research in Vocational Education, and the research cited, indicate some attention to preservice and inservice attention to technical teachers. In addition the national priority workshop, Post-Secondary Personnel Development (Doty and Gepner, 1976), focused on the problems of technical teacher education. Their basic finding was that technical teachers will participate in teacher education activities if there is administrative support and if there is some reward for such participation. They also will pursue those activities which improve technical competence rather than teaching competence, even though their supervisors may regard teaching competencies as equally important as technical competency.

#### CREDENTIALING

Christensen (1976) was concerned with the question of whether or not technical teachers used the teaching competencies they perceived as important. He collected data from a random sample (369) of teachers from Colorado, Florida, Minnesota, Nebraska, and New Mexico. His data analysis was based on 248 usable returns relative to the teachers' perceptions toward seventy-five competencies. Using the Statistical Package for the Social Sciences (SPSS) computer program analyses, Christensen found that the respondents rated sixty-three competencies as important and used fifty-nine of them. He concluded that technical teachers generally use the competencies they believe are important. He also found significant differences between importance and incidence of use of fifteen competencies. This finding indicates that these competencies were used less than might be expected when one considers that they were believed to be important. Based on the study findings it was recommended that certification requirements might be changed.

Delzer (1972) surveyed 20 percent of the full-time technical teachers and administrators having direct responsibility for

OUTLINE OF INSTRUCTION

c. Another unreliable connection.

(1) Pits in the solder.

(2) Wicking (insulation cut away to show extent).

(3) Dewetting.

(4) Nicked strand (between insulation and terminal).

INSTRUCTOR ACTIVITY

c. Display slide YXH  
L8-S33

STUDENT ACTIVITY

hh

8-10

## RETIRED TECHNICIANS

The National Center for Research in Vocational Education (1977) announced a project to support the strengthening of education through use of retired technicians. In this project, both younger and older adults benefit, as retired persons with trades, technical skills, and knowledge are urged to work with personnel in occupational, technical, and career education programs at the community college/postsecondary level. The project is being tested in two postsecondary institutions in Ohio.

OUTLINE OF INSTRUCTION

G. Safety Precautions

1. Work piece

(a) Same as rest of lessons

2. Tool

(a) Same as rest of lessons

811

INSTRUCTOR ACTIVITY

G. Display slide YXH L8-S34

3-1-49

STUDENT ACTIVITY

812

444

selection patterns over time, analyses indicated that program areas varied substantially in degree of stability and that individual program areas may have both stable and unstable aspects within their own patterns. Persons wanting to examine Copa and Kleven's follow-up questionnaire should contact the Minnesota Research Coordinating Unit.


Nelson (1976) was concerned with accessibility of occupational programs to students in "open door" colleges. To aid teachers and counselors in guiding students, he tested the applicability of Holland's theory of career development to personality and environmental types found in community college occupational programs. (Holland had hypothesized that satisfaction and achievement were a function of the interaction of personality and environmental types.) Data were collected from 425 volunteer students in four colleges of the North Carolina community college system. Student personality type was assessed using the Vocational Preference Inventory, satisfaction with the curriculum was assessed using the Curriculum Satisfaction Index, and biographic data were obtained from student data sheets. Multiple regression analysis and forward stepwise regression were employed.

Nelson found support for Holland's belief that persons tend to choose environments that are congruent with their personality types. However, he found a lack of support for Holland's hypothesis that congruency, consistency, and homogeneity are predictive of higher achievement and greater satisfaction in an environment. Nelson concluded that previous research lent (or "tended to support") support to Holland's framework which has helped counselors, teachers, and students organize their thoughts about occupations and that his study, too, supported Holland's theory.

Technical educators need to become more aware of the research concerning job selection patterns and job satisfaction. As has been stated by several researchers, the student will try to find jobs which will satisfy personal needs and cultural backgrounds. A technical educator's enthusiasm for his/her work area may overwhelm the student in the selection process.

#### MILITARY RESEARCH

Ball and Anderson of the Educational Testing Service worked with the Office of Naval Research, Personnel and Training Research Program, to study the theory and practice of training/education program evaluation. Their second report (October, 1975) consisted of (1) a national survey of 200 adult

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>3. Personal</p> <p><u>NOTE:</u> Teflon releases toxic fumes at 400 degrees F. Be especially careful when stripping wire as the element exceeds 400 degrees F and will cause fuming of Telefon insulation.</p>		<p>443</p>
<p>III. <u>APPLICATION</u></p> <p>Performance Sheet 3-1-1P</p>	<p>Supervise each student's completion of - - -, emphasizing safety; soldering performance.</p>	<p>Complete Performance Sheet. Ask questions if procedures are not clear.</p>
<p>IV. <u>SUMMARY</u></p> <p>A. Introduction</p> <p>843</p>	<p>A. Emphasize importance of the summary for the student.</p> <p>3-1-50</p>	<p>844</p>

full-time study and on-the-job training ensured the best rate of completion and that correspondence courses for the technical level should be used only for extenuating circumstances.

Miller's review of research (1974) for the Air Force was a notable contribution for technical educators interested in simulation and cost-fidelity simulation. He reviewed the uses of simulation in technical training with special emphasis on relatively inexpensive simulation and developed guidelines and general learning principles for using such simulation. Based on his review, Miller concluded that even though the fidelity of a training device for certain procedural tasks may be low, there may not be any adverse effects on measures of criterion performance. Also, the operation of complex electronic equipment may be simulated with simple, relatively inexpensive devices without any decrease in learner performance. Miller also concluded that, "In general, the methodologies that have been developed for the application of simulation have been long and cumbersome. Attempts at validating rules and principles have been relatively rare, and, as a result, little more is known now about the application of simulation in technical training than was known 20 years ago" (p. 1).

Haverland, at the Human Resources Research Organization, conducted a study for the Air Force (1974) to develop a model for matching training approaches or innovations with training setting, i.e., physical setting, personnel, and resources. The model contained two sets of questions concerning the requirements, resources, and constraint in the specific training setting and the factors in training approaches, i.e., any technique, device, or system considered for use in training. Answers to these two sets of questions provide the information needed to evaluate how well a training approach "fits" the training setting. The value of this research lies in the lists of questions - the most comprehensive the reviewers found - which could be used to improve the teaching/learning process. This model could be adapted and used by technical educators in their research in the public education system.

Hansen conducted a three-phased study (1973) concerned with individualizing instruction. The Phase I research objectives were to conduct a comprehensive review and analysis of state-of-the-art developments in adaptive instructional models and to recommend which instructional models were suitable for use in three Air Force technical training courses (Precision Measuring Equipment, Inventory Management, and Weapons Mechanic). Objectives of research tasks in Phases II and III were to provide computer simulations of the three instructional



<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>1. Nature of summary.</p> <p>2. Purpose of summary.</p> <p>B. Directions to students.</p> <p>1. Questions</p> <p>2. Notes</p> <p>815</p>		

hhh

Exchange (TRAIDEX) System. TRAIDEX is an information storage and retrieval system designed to reduce the cost of developing technical training courses within the armed services by allowing developers to have timely access to a comprehensive, up-to-date catalog of well-described and validated courses. The information collection and analysis that form the basis for these findings was performed during the period April, 1975 through April, 1976. The study indicated that the interservice sharing of validated technical course units can significantly decrease the time and cost required to produce courses for which identical or similar units must be developed. This view was supported both by qualified development personnel and by the experience of course developers who have reused course material from other services.

Valentine (1977) conducted a study with three main objectives: (1) to investigate the validity of the Armed Services Vocational Aptitude Battery (ASVAB) and of educational data for Air Force technical training, (2) to investigate unique elements of educational background and test data in predicting Air Force technical success, and (3) to assess homogeneity of prediction equations for subjects defined by race and sex. This study resulted from an Air Force Military Personnel Center request for an investigation of the ethnic fairness of education data as opposed to test scores for classification. Using the ASVAB, data were collected for all Air Force non-prior-service enlisted persons during the period September, 1973 to October, 1975. The analyses revealed that predictions for student success based on race and sex groups are more reliable than predictions based on test results and educational background of students. Success in this study was defined as grades received by students in the technical courses. It was emphasized by the researchers that the educational background of students as a predictor of success should not be used at this time because of bias in this type of information. The white male achieved the most success of sex and race groups in this study.

The research conducted by the various branches of the Armed Forces is comprehensive and thorough. The studies cited were those available in the ERIC system, but there are many others one might obtain through the Defense Documentation System. To summarize this research, it was found that adult technical programs have not been adequately evaluated and that guidelines for evaluation must be structured to compensate for the varied program environments. Full-time and on-the-job education were the most successful, based on program completion rates. Correspondence courses were not too successful for technical instruction, but low fidelity simulation was successful. Incentive motivation must be based on strong reward, e.g., money and gift certificates. Prediction of program success based on sex and race was more

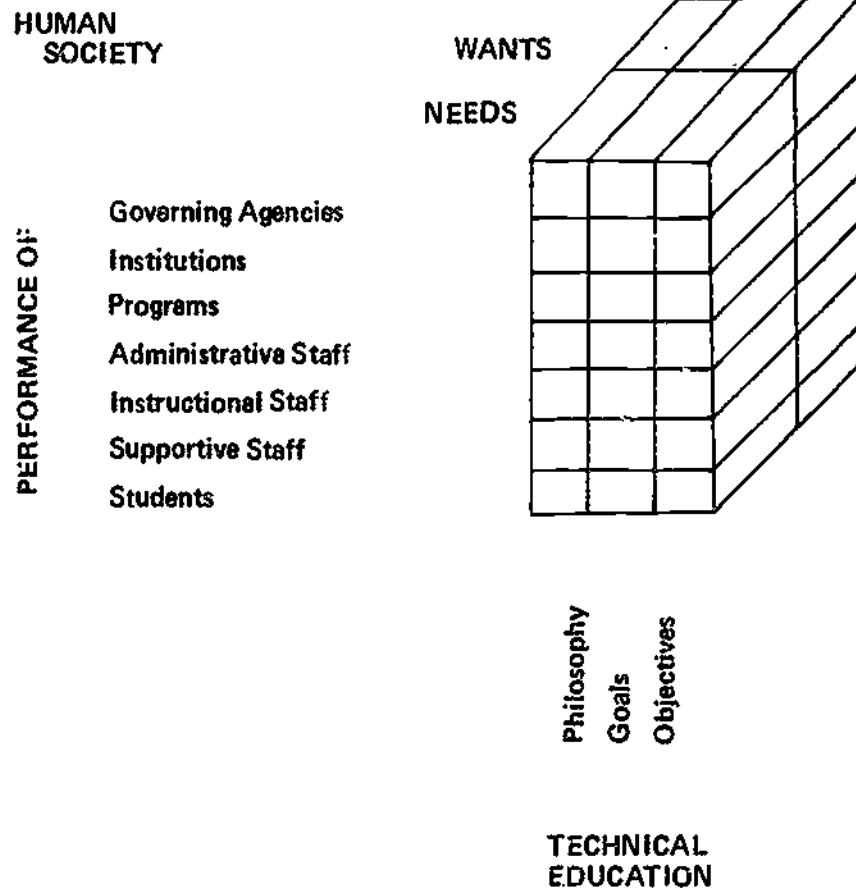
<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
C. Recap of lesson	C. Emphasize safe	C. Ask questions if material not clear; check notes to insure accuracy and completeness.
V. <u>INFORMAL TEST</u>		
There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application."		
VI. <u>ASSIGNMENT</u>	VI. Provide students with homework assignment.	VI. Ask questions if the assignment is unclear.. Complete assignment.

445

815

817

Figure 2: Research Matrix



FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminature Electronic Repair  
(2M) Program A1000034

Security Classification: UNCLASSIFIED

Lesson Topic 3.2:  
Soldering to Hook and Pierced Tab Terminals

Time Allocation: Classroom 1.75 Hours  
Laboratory 5.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides YXH L9-S1 thru YXH L9-S28

3. Training Aids Equipment

- a. Projector, Slide
- b. Screen, Projector, Standard

4. Text

- a. Student's Guide

5. References

- a. MIL-STD-454D

- b. NHB-5300.4 (3A)

- c. NASA SP-5002

TERMINAL OBJECTIVE:

Supported partially by this lesson topic:

- 5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4 (3A).

ENABLING OBJECTIVES:

When you complete this lesson topic, you will be able to:

- 3.2.1 PREPARE hook and tab terminals for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.
- 3.2.2 PREPARE wires for soldering by stripping and tinning following the procedures and to the standards outlined in MIL-S-45743C.
- 3.2.3 CONNECT prepared wires to hook and pierced tab terminals using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4 (A).

American Society for Engineering Education were not valid predictors of job success (Maner, 1972).

With regard to articulation of programs between educational institutions, e.g., secondary vocational schools and community colleges, it was found that articulation was hindered due to the separation among institutions and associations. State organizational structure was found to have a significant impact on articulation (Bender, 1973; Bushnell, 1978; Fishkind, 1976; Keeling, 1973; Roy, 1972).

Attrition of students, one of the biggest problems of community colleges, was difficult to understand. Information on this topic is inadequate and there are numerous reasons for attrition. The studies concluded that no one single act could be determined to stop attrition (Michlein, 1976; Puffer, 1971). Potential technical students who did not enter school did so because they postponed plans, could not decide, found a permanent job, needed to earn money, or wanted a different program or a different school. Lack of financial aid and ignorance of availability of such aid caused some persons not to enroll, as did a lack of transportation and a general lack of information about the colleges (Jaeger, 1976).

Persistors in technical curricula did not change their perceptions of their chosen occupational program (Farber, 1971; Gillie and Basualdo, 1973). More persistors than dropouts attended small rural high schools. Many students lacked satisfactory high school preparation for technical education (Puffer, 1971). Dropouts had significantly lower math and social studies examination scores in high school (Greenfield, 1976; Kollin, 1971; Puffer, 1971). Students who had an occupational commitment in mid-high school had greater persistence and graduation rates (Garbin & Vaughn, 1971). And, perhaps not surprisingly, the more influence parents had on student registration, the higher the dropout rate (Puffer, 1971).

Full-time study and on-the-job training ensured the best rate of completion in technical training (Veterans Administration, 1976 a). Correspondence training produced low completion rates for technical training. In fact, the more technical the curricula, the greater the dropout rate (Veterans Administration, 1976 a). Predictions of success in technical training were more valid using race and sex groups than educational background (Valentine, 1977).

The criteria for selection of chief administrators of technical education in two-year colleges should be a doctorate in education, exposure to the two-year college, and occupational

### CRITERION TEST

Given selected hook and pierced tab terminals the student will be required to prepare the terminals and necessary wire for soldering and then connect the wires to the terminals completing a minimum of two single and one double connection on each terminal style in accordance with the procedures and to the standards outlined in Performance Sheet 3-2-1P.

### HOMEWORK

Read and study Notetaking Sheet 3-2-1N.





planning and professional role (Foreman, 1975). The greatest concern among adjunct instructors was a lack of course outlines from the college; their supervisors concurred that selecting and organizing content was one of the adjuncts' prevalent weaknesses (Schmitt, 1971).

The military training systems have been confronted with the high cost of technical education programs and have sought ways to reduce equipment costs. In one study, it was found that low fidelity equipment simulation did not adversely affect learner performance (Miller, 1974).

A number of findings were reported regarding technical students. Students differed in certain characteristics among types of institutions and in job success as measured by the sixteen Personality Factor Questionnaire and other tests (Mayer, 1971; Rothwell, 1970; Wiggle, 1977). Successful technical students may be distinguished from unsuccessful students by certain nonintellectual characteristics (Ingram, 1973). There were differences between the evening student and the day student. The evening student was older and more likely to be working full time; the day students made a career choice earlier, were helped more by counselors, and were more concerned with grades (Webb, 1971). Holland's theory that persons tend to choose environments congruent with their personality types seems warranted (Nelson, 1976).

As a group, students who followed a college prep program in high school achieved significantly higher than the high school vocational group in college technical math and science. Students who followed a vocational program in high school had a higher degree of job satisfaction than college prep majors in high school (Killin, 1971). The mean reading level of junior college students varied from one to four grade levels below the mean readability levels of texts used in instructing them (Karnes & Ginn, 1976). The humanities requirements for occupational programs demonstrated that students must adapt themselves to the college rather than the college serving the students (Kroeger & Brace, 1971). Instructional staff, counselors, and administrators have marginal influence on students with academic and personal problems (Puffer, 1971).

The community colleges have 50 percent of their students in occupational programs (Senier & Enderlein, 1973). Only 56.2 percent of all occupational students enrolled in a community college intended to prepare for employment in that career area (Lach, 1978). Many students entered college with short term objectives and could complete their objectives by enrolling in a few courses (Lach, 1978). A high percentage of graduates were employed in occupations related to their programs (Noeth

and Hanson, 1975). Most were highly satisfied with their present occupations (Lach, 1978; Noeth and Hanson, 1975; Shimada, 1976; Tari and Maiers, 1974). Most feel they could not have obtained their present job without technical education (Harris, 1972; Noeth & Hanson, 1975). Placement rates for community college occupational students were higher than those for baccalaureate students (Lach, 1978). Rates for the majority of community college occupational students were higher than those of baccalaureate students (Lach, 1971). The majority of community college occupational students took jobs in the college district which they attended (Buzzell, 1970; Lach, 1978; "World Business," 1978.) Graduates expressed concern with the lack of a practical relationship between the courses offered in general studies and their technical studies (Reburn, 1971; Tari and Maiers, 1974). Graduates of associate degree programs, in continuing their education, choose the following areas in order of priority: mathematics, biological and physical science, social science, and fine arts (Gillie, 1973). The poor job market caused many graduates to take jobs which were not their priority (Gillie and Mann, 1973).

Although there was no indication that other types of technical instructors disliked their textbooks, the electronics technology instructors were not satisfied with the textbooks available in their area. They believed the texts did not contain enough realistic material (Cheshier, 1974).

Research findings concerning women showed that women can be attracted to traditionally male-oriented fields and will enroll in community college technical programs. However, unless recruitment is conducted, enrollment of women will be slight, according to several reports (Boyer, 1973; Mintz, 1976). Sex bias exists among both male and female postsecondary occupational educators and tends to increase with the years of teaching experience (Manrov, 1977). Women engineering students continued to receive higher salaries than did males (Engineers Joint Council, 1977).

#### RESEARCH PRIORITIES

Walter Brooking and Albert Riendeau, of the United States Office of Education, Postsecondary and Adult Occupational Programs Branch, were asked for their opinions on technical education research. Brooking replied for both on April 27, 1978 and his comments with regard to categories of research needs are quoted at some length here.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Accomplishment of daily tasks aboard ship.
2. The necessity of the skills and techniques in repair of printed circuit boards.
3. Personal applications of the knowledge and skills.
4. Seek to motivate. Tell a good tie-in story if possible.

bhh

854

successful, high quality technical education programs. For want of this type of information we feel that the staff development efforts often provided by teacher leadership developing institutions can be superficial and fail(s) to get down to really important elements in technical education program initiation and administration which make a unique and high quality effort. We believe that much could be learned from the private institutions who live by tuition and continue year after year to provide graduates which in many cases are the pacesetters for employment in their field.

Charles O. Whitehead, president-elect of AVA, responded with the following points:

Continuation and expansion of the articulation study started by the AVA/AACJC Joint Study Project, headed by David Bushnell, must be accomplished. This to me holds the greatest potential in the total postsecondary vocational education sector. Potential of expanding technical education efforts in such areas as CETA, economic development, correctional institutions, etc. (1978)

Jake Salley, the vice-president-elect of the Technical Education Division of the American Vocational Association, reported his views with the following list of priorities:

Program Evaluation. There is an ever growing need to know the acceptable and recognized methods and procedures for the evaluation of programs. This should not be just from the standpoint of whether to continue a program but also from the basis of improvement.

Teacher Qualifications. What are the recognized standards for a quality teacher in a technical program?

Teacher Loading. This presents problems in a comprehensive college. There is continued concern among faculty and administration as to the teaching load of faculty members. (1978)

Suggestions for research were included in many of the studies reviewed in this report. In particular, references to priority research can be found in studies by Buder (1969), Farning (1975),

OUTLINE OF INSTRUCTION

C. Effect

D. Overview

INSTRUCTOR ACTIVITY

C. When following a subject matter lesson topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).

2. Commend students for mastery of skills in previous lesson(s).

D. Overview lesson by:

STUDENT ACTIVITY

## Evaluation

Evaluation and accountability are most pressing issues. In spite of this immediacy, evaluation needs to be researched. Most research has concentrated on process measures of program quality. Process should only be described as a means to infer that certain student outcomes have resulted. If meaningful measures of quality technical education programs are to be obtained, measures must be extended beyond the usual follow-up study variables into such crucial variables as occupational success, satisfaction, and advancement.

## Instruction

Much work needs to be accomplished here. One specific problem, due to an increasing lack of funds, is the inability of institutions to obtain standard industrial equipment. Simulation techniques need to be designed and tested using less-than-industrial-level equipment to achieve skills transferable to industry.

## Liberal Arts

Liberal arts studies which report information relevant to the technical education student need to be identified. This applies to the need for all persons to develop their human relations skills.

## Perceptions

A critical review of the value of studies of perceptions by different populations toward technical education should be considered.

## Politics and Research

The effects of politics on the interpretation of research, the information collected, and even the funding of research need to be studied. This is particularly so in areas where educators are cautious because negative results may affect public perceptions of technical education.

## Private and Public

Recent federal and state legislation has expanded the number of private educational agencies that may offer technical

451

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Stating learning objectives as contained on cover pages to this topic.

2. Stating procedures to be followed during the lesson.

a. Taking notes

b. Asking questions

c. Use of criterion test

858

851

## SOME ADDITIONAL RESOURCES

### I. Some books with an historical perspective:

- Brooking, Walter. Criteria for Technician Education.
- Gillie, Angelo C. Principles of Post-Secondary Vocational Education.
- Graney, Maurice R. The Technical Institute.
- Harris, Norman C. and Grede, John F. Career Education in the Colleges.
- Miller, Aaron and Gillie, Angelo C. A Suggested Guide for Post-Secondary Vocational Education.
- Technician Education Yearbook (first edition was published in 1963).

### II. Key journals, yearbooks, national conference reports, newsletters, and periodic reports:

- American Technical Education Association, Inc. Journal is the official journal of the ATEA designed to provide members with an opportunity to exchange ideas among persons in the technical education field.
- Annual Conference on New Horizons in Community College Occupational-Technical Education (by James Hoerner) conducted at Virginia Polytechnic Institute and State University contains reports by leaders in technical education on various issues, problems, and programs.
- Annual Pennsylvania Conference on Post-Secondary Occupational Education is a conference first held in 1969 (Gillie, October 6-8, 1969) for persons interested in topics and problems concerning occupational education. The conferences have been planned to cover the topics of evaluation (Gillie, 1971), social and health related services (Gilli, 1972), articulation and coordination between secondary and postsecondary education (Gilli,\*1973, 1974, and 1976), continuing and adult education (Gilli, 1975), accommodating change in post-secondary occupational education (Martorana et al., 1977), programming

\*NOTE: Dr. Gillie changed the spelling of his name from Gillie to Gilli.



## OUTLINE OF INSTRUCTION

### II. PRESENTATION

A. Types, sizes and usage of hook and tab terminals.

1. Common types and sizes

a. Types

## INSTRUCTOR ACTIVITY

3. Invite questions concerning objectives

A. Explain and describe the types and sizes of hooks tab terminals while projecting slides.

1. Display slide YXH L9-52

## STUDENT ACTIVITY

3. Ask questions concerning objectives or procedures if in doubt.

1. Students take notes and ask questions

announcements, research, and the like.

- Technical Education Research Centers, Inc. - Southwest, a nonprofit corporation, carries out research projects, develops curricula, and disseminates program information on technical occupations that require postsecondary education. Present research pertains to energy use and conservation technicians.
- Technical Education Yearbook, started in 1963, contains information on issues, problems, proposals, federal legislative developments, case studies of programs, program descriptions, directories of institutions and officials, and listings of professional organizations concerned with technical education.
- Technology Today is a publication in which technical educators and industrial personnel can share experiences, problems, philosophies, research, programs, and technical expertise.
- The VRE Technical Education Newsletter provides information on recent engineering and technical education conferences, technical discoveries, and faculty improvement projects.

See also - publications by the Engineers Council for Professional Development concerning accreditation, professional development, ethics, guidance, and special topics: Engineers Council for Professional Development, Publications Office, 345 East 47th Street, New York, New York 10017.

In addition, the American Vocational Association recognized the National Association of Instructional Leaders in Technical Education (NAILTE) at the December 4, 1978 national convention. The primary purpose of the NAILTE is to upgrade communication between technical educators and to increase the professional competencies of its members.

### III. Bibliographies:

- For the person seeking resource materials, Reinhart's bibliography, Vocational-Technical Learning Materials, 2nd edition (1974) has a listing of 5,167 books and 394 journals pertaining to various vocational and technical areas. The materials relate to nonprofessional instructional programs requiring less than a baccalaureate to complete. The

OUTLINE OF INSTRUCTION

(1) Hook (question mark style)

(2) Hook ("J" shape)

(3) Tab (pierced tab eyelet)

b. Sizes

(1) Many sizes are used depending on current-flow requirements of the device.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

453

863

802

## REFERENCES

- A Central Office Self-Study of the South Carolina State Board for Technical and Comprehensive Education. Columbia: South Carolina State Board for Technical and Comprehensive Education, 1976. (ED 139 453)
- Adams, D.A. Review and Synthesis of Research Concerning Adult Vocational and Technical Education. Columbus, Ohio: The National Center for Research in Vocational Education, 1972. (ED 064 469)
- Alden, J.D. Prospects of Engineering and Technology Graduates 1970. New York, New York: Engineers Joint Council, 1970. (ED 052 937)
- \_\_\_\_\_ and Vachula, C. Engineering and Technology Enrollments Fall 1973. New York, New York: Engineers Joint Council, 1974. (ED 091 231)
- American Society for Engineering Education. Engineering Technology Education Study: Final Report. Washington, D.C.: ASEE, 1972.
- \_\_\_\_\_. Engineering Technology Education Study: Interim Report. Washington, D.C.: ASEE, 1971.
- American Vocational Association. Special Report: Vocational Education Appropriations for FY '79: A National Plan for Action. Washington, D.C.: A.V.A., 1978.
- Ammadi, M.A. A Comparison of Teacher and Student Perceptions of Certain Objectives for Three Agricultural Occupations in Illinois Junior Colleges. Ph.D. dissertation, Urbana: University of Illinois, 1971.
- Anderson, D.A. A Review and Synthesis of Technical Education Research in Oklahoma. Stillwater: Oklahoma Vocational Research Coordinating Unit, 1970. (ED 039 328)
- Anderson, S.B.; Ball, S.; Murphy, R.T.; and Associates. Encyclopedia of Educational Evaluation. San Francisco, California: Josse-Bass Publishers, 1975.
- Ash, L.C. et al. Instruments and Procedures for the Evaluation of Vocational/Technical Education: Institutions and Programs. Washington, D.C.: American Vocational Association, National Study for Accreditation of Vocational/Technical Education, 1971.

OUTLINE OF INSTRUCTION

(2) Terminal size and wire size should correspond.

2. Uses

a. Hook and tab terminals are used to provide connection points on sealed devices and terminal boards.

b. Tab terminals are usually connection points on the rear of edge connector receptical pins.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

Borgen, J.A. and Davis, D.E. An Investigation of Curriculum Development and Evaluation Models with Implications Toward a Systems Approach to Curriculum Development and Evaluation in Occupational Education as Part of Phase II Report. Joliet, Illinois: Joliet Junior College, 1971. (ED 060 201)

Bowers, E. Occupational Education Information Needs and Governance Patterns in Selected California Community Colleges. Sacramento: California Community Colleges, Office of the Chancellor, 1975. (ED 132 261)

Boyer, E. Women - Are Technical-Occupational Programs Attracting Them? Cleveland, Ohio: Cuyahoga Community College, 1973. (ED 085 065)

Boyett, R.H. and Thomas, H.B. Baseline Data for Teacher Education. Paper presented at the annual meeting of the American Education Research Association, New York, New York, April, 1977. (ED 138 562)

Braden, P.V. and Paul, K.K. Nuclear Technician Manpower Survey: Approach to an Information System. Atlanta, Georgia: Southern Interstate Nuclear Board, 1971. (ED 066 583)

Brooking, W. Criteria for Technician Education: A Suggested Guide. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1968. (ED 027 417)

Bureau of Education for the Handicapped. Proceedings of the Conference on Research Needs Related to Career Education for the Handicapped: January 17-19, 1975. Princeton, New Jersey: Educational Testing Service, 1975. (ED 121 001)

Burger, L.J. and McKeever, R. Developing Articulated High School and Post High School Vocational Technical Curricula in Minnesota. Final Report. Minneapolis, Minnesota: Research Coordinating Unit for Vocational Education, 1975. (ED 118 749)

Bushnell, D.S. Cooperation in Vocational Education: AACJC/AVA Joint Study. Arlington, Virginia: American Vocational Association, 1978. (ED 160 150)

Buzzell, C.H. Incidence of Geographic and Occupational Mobility Among Certified Electronic Technicians in the Middle Atlantic States. Ed.D. dissertation, New Brunswick, New Jersey: Rutgers - The State University, 1971.

### OUTLINE OF INSTRUCTION

- c. When this type of terminal is used, the connections are normally made in an end-on manner to the device.

B. Preparing hook and tab terminals for soldering.

#### 1. Cleaning

- a. Terminals must be cleaned prior to attaching leads or connectors by:

- (1) Adding new solder and removing excess in order to tin surface and remove oxides.

### INSTRUCTOR ACTIVITY

B. Display Slide YXH L9-S3

### STUDENT ACTIVITY

455

866

- Cotrell, C.J. and Doty, C.R. Assessment of Micro-Teaching and Video Recording in Vocational and Technical Teacher Education: Phases I-X. Columbus, Ohio: The National Center for Research in Vocational Education, 1971. (ED 052 325, ED 057 189-194, ED 039 318, ED 057 206, ED 057 201, and ED 042 901)
- Cross, P.K. Occupationally Oriented Students. Washington, D.C.: American Association of Junior Colleges, 1970. (ED 043 328)
- Dagenais, F. Identification of Most Successful Educational Programs and Their Characteristics. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, Illinois, April, 1974. (ED 098 257)
- Delzer, C.L. Credentialing Technical Teachers. Ph.D. dissertation, Ft. Collins: Colorado State University, 1972.
- Divine, L.E. Attitudes Toward Occupational Education in the Community Junior College. Ph.D. dissertation, Fayetteville: The University of Arkansas, 1974.
- Doggette, J.R., ed. Energy-Related Technology Programs in Community and Junior Colleges: An Analysis of Existing and Planned Programs. Oak Ridge, Tennessee: Oak Ridge Associated Universities' Manpower Development Division, 1976. (ED 125 703)
- Doty, C.R. Full Time Equivalent (FTE) and Definitions for Postsecondary Vocational Education and Adult Vocational Education. New Brunswick, New Jersey: Rutgers - The State University, 1978. (ED 155 338)
- \_\_\_\_ and Gepner, R., eds. Post-Secondary Personnel Development: Volume 1. Trenton, New Jersey: Mercer County Community College, 1976a. (ED 131 891)
- \_\_\_\_ and Gepner, R., eds. Post-Secondary Personnel Development: Volume 2. Trenton, New Jersey: Mercer County Community College, 1976b. (ED 131 892)
- \_\_\_\_ and Isaac, G. Recommendations for Research for Handicapped in Career Education. In Bureau of Education for the Handicapped. Proceedings of the Conference on Research Needs Related to Career Education for the Handicapped: January 17-19, 1975. Washington, D.C.: Research Projects Branch, 1975. (ED 121 001)



OUTLINE OF INSTRUCTION

(2) On new untarnished terminals, the use of solvent alone for cleaning is often sufficient.

- b. If terminals are handled during joint preparation, they must be recleaned with solvent as a final step prior to soldering.

2. Tinning

- a. Used or tarnished terminals should always be tinned prior to soldering.
- b. The tinning process enhances solder flow on the connection and cleans oxides from the terminal.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- Fibel, L. R. Review and Synthesis of Literature on Occupational Preparation in the Community College. Columbus, Ohio: The National Center for Research in Vocational Education, 1972. (ED 061 416)
- Fish, D. San Francisco Bay Area Environmental Education Needs Study. Campbell, California: West Valley Joint Community College District, 1972. (ED 075 620)
- Fishkind, H.H. Methodology for Determining Needs for Vocational and Technical Education in Urban Areas in Florida. Gainesville: Florida University, College of Business Administration, 1976. (ED 134 720)
- Florida State Advisory Council on Vocational and Technical Education. Measures of Success: A Survey of Selected Vocational and Technical Education Programs in Florida which Train Students in Occupations Requiring Licenses. Tallahassee: Florida State Advisory Council on Vocational and Technical Education, 1976. (ED 132 260)
- Foreman, J.L. An Assessment of Perceptions of Competencies Needed by Post-Secondary Vocational-Technical Teachers in Texas. Ph.D. dissertation, College Station: Texas A & M University, 1975.
- Fortney, H.M. Performance Based Instruction Curriculum Development in Vocational Education - The State of the Art. Montgomery: Alabama State Department of Education, Division of Vocational Education and Community Colleges, 1975. (ED 137 497)
- Gammel, J.M. et al. Follow-Up Study of 1969-1975 Graduates of the Division of Technology of New York City Community College. Brooklyn, New York: New York City Community College, 1976. (ED 121 396)
- Garbin, A.P. and Vaughn, D. Research and Development Series No. 53, Community-Junior College Students Enrolled in Occupational Programs: Selected Characteristics, Experiences and Perceptions. Columbus, Ohio: The National Center for Research in Vocational Education, 1971. (ED 057 196)
- Gasior, A.G.; Kocinski, R.R.; and Doty, C.R. Model for Cost Per Pupil. New Brunswick, New Jersey: Rutgers - The State University, Department of Vocational-Technical Education, 1975. (ED 114 494)
- Gauthier, M.K. Instrumentation Technology: A Curriculum Study. Ed.D. dissertation, Los Angeles: University of California, 1972.

OUTLINE OF INSTRUCTION

C. Preparing wire for soldering to hook and tab terminals.

1. Tools used

a. Mechanical and/or thermal wire strippers.

b. Soldering iron

c. Antitwisting devices

INSTRUCTOR ACTIVITY

C. Display Slide YXH L9-S4

STUDENT ACTIVITY

457

371

- \_\_\_\_\_. Principles of Post-Secondary Vocational Education. Columbus, Ohio: Charles E. Merrill Publishing Company, 1973.
- \_\_\_\_\_. The Second Annual Pennsylvania Conference on Post-Secondary Occupational Education: Evaluation of Post-Secondary Occupational Education. University Park: The Pennsylvania State University, Center for the Study of Higher Education, 1971. (ED 056 221)
- \_\_\_\_\_. The Third Annual Pennsylvania Conference on Post-Secondary Occupational Education: Social and Health Related Services. University Park: The Pennsylvania State University, Center for the Study of Higher Education 1972. (ED 072 194)
- \_\_\_\_\_. et al. Continuing Education Characteristics of Selected Associate Degree Graduates. University Park: The Pennsylvania State University, Department of Vocational Education, 1973. (ED 078 191)
- \_\_\_\_\_. and Basualdo, E. A Study of Changes in Occupational Ratings by Selected Associate Degree Graduates. University Park: The Pennsylvania State University, Department of Vocational Education, 1973. (ED 079 523)
- \_\_\_\_\_. and Mann, E. Job Satisfaction Characteristics of Selected Associate Degree Graduates. University Park: The Pennsylvania State University, 1973. (ED 078 190)
- Goldstein, H. and Swerdloff, S. Methods of Long Term Projection of Requirements for Supply of Qualified Manpower. Paris, France: UNESCO, 1967. (ED 026 457)
- Golladay, M.A. The Condition of Education 1976 Edition. Washington, D.C.: The National Center for Education Statistics, 1976.
- Graney, M.R. The Technical Institute. New York, New York: The Center for Applied Research in Education, Inc., 1964.
- Grant, W.V. et al. Digest of Education Statistics 1975 Edition. Washington, D.C.: National Center for Education Statistics, 1975.
- Greenfield, D.R. Condensing Algebra for Technical Mathematics. Ph.D. dissertation, Ft. Lauderdale, Florida: Nova University, 1976. (ED 137 003)
- Guerard, M.P. A Study of Texas Junior College Drafting and Design Technology Curricula for Development of a Planning Guide. Ph.D. dissertation, College Station: Texas A & M University, 1971.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
d. Vice		
e. Round nose pliers		
f. Nylon rod		
g. Flush-cutting pliers		
2. Stripping		

- \_\_\_\_\_. et al. Employability: Review and Survey. Madison: Wisconsin Vocational Studies Center, 1978.
- Haverland, E.M. Transfer and Use of Training Technology: A Model for Matching Training Approaches With Training Settings. Alexandria, Virginia: Human Resources Research Organization, 1974. (ED 109 489)
- Hedlund, D.E. et al. A Decision System for Occupational Programs in Community Colleges. Albany: New York State Department, Bureau of Two-Year College Programs; Albany: New York State Department, Office of Occupational Education; Ithaca: State University of New York; Ithaca: Cornell Institute for Research and Development in Occupational Education, 1974. (ED 099 042)
- Heinkel, O.A. and Tepedino, F.J. An Assessment of the Marine Industry and Marine Technology Programs in Community Colleges in San Diego County. Final Project Report. Sacramento: California Community Colleges, Office of the Chancellor; San Diego: San Diego Community College District Research Office, 1972. (ED 081 420)
- Hirst, B. An Assessment of the Perceived Utility of Self-Study Activities Performed During the Process of Accreditation of Selected Post-Secondary, Non-Collegiate Occupational Education Institutions. Ed.D. dissertation, Knoxville: University of Tennessee, 1974.
- Hoerner, J.L. Fourth Annual Conference on New Horizons in Community College Occupational-Technical Education: Challenges of the Future in Postsecondary Occupational Education. Blacksburg: Virginia Polytechnic Institute and State University, 1977. (ED 145 087)
- \_\_\_\_\_. and Lear, G.M., Jr. Fifth Annual Conference in Community College Occupational-Technical Education: New Horizons in Community College Occupational Technical Education: Alternatives for Post-Secondary Career Education. Blacksburg: Virginia Polytechnic Institute and State University, 1978.
- Holman, M.G. Evaluation of a Teacher Education Program in Electromechanical Technology. Ed.D. dissertation, Stillwater: Oklahoma State University, 1972.
- Hood, B. Program Goals of South Carolina Technical Colleges. Ph.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1977.

OUTLINE OF INSTRUCTION

- a. Same techniques and procedures as those taught for wire preparation when soldering turret terminals.

3. Tinning

- a. Same techniques and procedures as those taught for wire preparation when soldering turret terminals.

4. Bending

- a. Any method may be used for bending wire that does not damage the wire in any way.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

459

875

874

Kievit, M.B. Expectations for Learning Environments and Personality Factors of Students Compared to Drop-Outs from Two Year Institutions. Paper presented at the annual meeting of the American Educational Research Association, New York, New York, February, 1971. (ED 047 667)

\_\_\_\_\_. Review and Synthesis of Research on Women in the World of Work. Columbus, Ohio: The National Center for Research in Vocational Education, 1972. (ED 066 553)

Kim, J.E. Administrators Manual Cost-Effectiveness/Benefit Analysis of Postsecondary Vocational Programs. Bloomington: Indiana University, Department of Vocational Education, School of Education, 1977a.

\_\_\_\_\_. National Priority Training Project: Developmental Strategies and Evaluation Techniques for Improving the Cost-Effectiveness of Vocational Programs: July 1, 1977 - June 30, 1978. Bloomington: Indiana University, Department of Vocational Education, School of Education, 1978.

\_\_\_\_\_. Technical Report A Cost-Effectiveness/Benefit Analysis Model for Postsecondary Vocational Programs. Bloomington: Indiana University, Department of Vocational Education, School of Education, 1977b.

Kingsinger, R.E. Health Technicians. Chicago, Illinois: J.G. Ferguson Publishing Co., 1970.

Klare, G.R. "Assessing Readability." Reading Research Quarterly. 10(1974-75): 62-102.

Kolendrianos, H.T. Analysis of Current In-Service Education Practices of Full-Time Occupational-Technical Instructors in the Virginia Community College System. Ph.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1977.

Kollin, R. A Study of the Effects of High School Mathematics on the Academic and Job Achievements of Selected Community College Technical Graduates. Ph.D. dissertation, Detroit: Wayne State University, 1971.

Komar, J.J. The Qualifications, Positions, and Problems of Chief Administrators of Vocational-Technical Education in Public Two-Year Colleges in the United States with Special Reference to Michigan. Ph.D. dissertation, E. Lansing: Michigan State University, 1973.



OUTLINE OF INSTRUCTION

(1) Round nose pliers

(2) Nylon rod

(3) Dummy terminal

b. Care must be taken not to crush, overstress, or birdcage the wire during the bending operation.

D. Hook and tab terminal solder connection specifications.

1. Wire wrap

INSTRUCTOR ACTIVITY

1. Display Slide YXH L9-S5

STUDENT ACTIVITY

McLennand, B.T. A Developmental Study of Automotive Programs in Two-Year Colleges with Implications for a Planning and Standards Guide. Ed.D. dissertation, College Station: Texas A & M University, 1971.

McManis Associates, Inc. Study of Residential Vocational Centers in Maryland: Part II. Washington, D.C.: McManis Associates, Inc., 1975. (ED 122 096)

Magisos, J.H. and Stakelon, A.E. Adult Vocational Education: An Annotated Bibliography of Publications and Projects. Columbus, Ohio: The National Center for Research in Vocational Education, 1975.

\_\_\_\_\_. Post-Secondary Vocational Education: An Annotated Bibliography of Publications and Projects. Columbus, Ohio: The National Center for Research in Vocational Education, 1975.

Maner, A.H. An Evaluation of the Relationships Between Selected Curriculum Factors and Successful Employment of Engineering Technicians. Ph.D. dissertation, College Station: Texas A & M University, 1972.

Maney, T.J. The Feasibility of Implementing a Basic Planning, Programming and Budgeting System within the Technologies and Pre-Engineering, and Business Instructional Areas of Nicolet College and Technical Institute, Wisconsin's Pilot Dual Track Institution. Ed.D. dissertation, Minneapolis: University of Minnesota, 1972.

Manrov, A. Basic Beliefs Regarding Sex Bias Among Postsecondary Occupational Educators in Region Three. Ph.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1977.

Martorana, S.V. et al. Eighth Annual Conference on Postsecondary Occupational Education: Accommodating Change in Postsecondary Occupational Education. University Park: Pennsylvania State University, Center for the Study of Higher Education, 1977. (ED 139 495)

\_\_\_\_\_. The Ninth Annual Pennsylvania Conference on Postsecondary Occupational Education: Programming Postsecondary Occupational Education. University Park: The Pennsylvania State University, Center for the Study of Higher Education, 1978.

### OUTLINE OF INSTRUCTION

- a. In all cases, for hook and tab style connections, the minimum wrap around the terminal shall be 90 degrees (1/4 turn)
- b. The maximum wrap shall be no more than 270 degrees (3/4 turn)
- c. For tab type terminal connections the recommended wire wrap is 180 degrees. The wire should be flush-cut, after bending at 180 degrees.
- d. For hook or "J" type terminal connections the recommended wrap is 120 degrees. The wire should flush-cut after bending at 120 degrees.

### INSTRUCTOR ACTIVITY

- c. Display Slide YXH L9-S6  
Stress 180 degrees preferred for pierced tab
- d. Display Slide YXH L9-S7  
"Stress 120 degrees to 160 degrees for hook type

### STUDENT ACTIVITY

461

870

873

- Mintz, F. Development of a Model for the Recruitment of Mature Women in Traditionally Male-Oriented Occupational Education Programs. Ed.D. dissertation, New Brunswick, New Jersey: Rutgers - The State University, 1976.
- Moffitt, M.C. Handbook for Evaluating Disadvantaged and Handicapped Students for Planning Occupational Education Programs. Raleigh, North Carolina: Division of Occupational Education, Department of Public Instruction, 1970.  
(ED 052 342)
- Morris, W. and Gold, B.K. Student Accountability Model: Procedures Manual. Vocational Education, Part C. Sacramento: California Community Colleges, 1974. (ED 097 071)
- National Center for Research in Vocational Education. Directory of Task Inventories, Vol. 1. Columbus, Ohio: The National Center for Research in Vocational Education, 1974.
- \_\_\_\_\_. Directory of Task Inventories, Vol. 2. Columbus, Ohio: The National Center for Research in Vocational Education, 1975.
- \_\_\_\_\_. Directory of Task Inventories, Vol. 3. Columbus, Ohio: The National Center for Research in Vocational Education, 1976.
- \_\_\_\_\_. "Post-Secondary Vocational-Technical Personnel Development Project." Centergram. 13(March, 1978).
- \_\_\_\_\_. "Project Assert: Use of Retired Technicians as Volunteers to Strengthen Postsecondary Occupational Education." Centergram. 12(November, 1977).
- National Science Board. Science Indicators 1976 - Report of the National Science Board 1977. Washington, D.C.: U.S. Government Printing Office, 1977.
- Nelson, D.L. Using Hollands Theory and Selected Demographic Variables in Predicting Achievement and Satisfaction with Curriculum Choices of Post Secondary Occupational Studies. Ph.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1976.
- Nelson, M.J. and Denny, E.D. The Nelson-Denny Reading Test. Examiners Manual. Boston, Massachusetts: Houghton Mifflin Company, 1973.
- New Educational Direction, Inc. Evaluation of Vocational Technical Education. Phase 1. A Review of the Literature. Crawfordsville, Indiana: New Educational Directions, Inc., 1975.  
(ED 131 333)

### OUTLINE OF INSTRUCTION

- e. The cut for 120 degrees is not straight across the wire but angled to form a flush surface with the side of the terminal when installed.

### 2. Wire position

- a. Proper position of wire on hook terminals requires that it be firmly in contact with the terminal mounting surface.
- b. Connection to a hook terminal. Near maximum wrap is used rather than the optimum. This wrap is not preferred since it makes the wire difficult to remove.

### INSTRUCTOR ACTIVITY

- e. Display Slide YXH L9-S8

- a. Display Slide YXH L9-S9

- b. Display Slide YXH L9-S10

### STUDENT ACTIVITY

- Prizzia, R. Manpower Survey Project: A Survey of Industry Opinion. Honolulu, Hawaii: Honolulu Community College, 1973. (ED 096 554)
- Puder, W.H. Priorities for Vocational-Technical Education Research in North Carolina. Raleigh: North Carolina State University, 1969. (ED 036 756)
- Puffer, K. A Study of Student Characteristics at a Post Secondary Institute of Technology. Ed.D. dissertation, Urbana: University of Illinois, 1971.
- Rasmussen, O.A., Jr. Conceptualizations of Teaching Roles for Computer Related Instruction in Community College Technology Programs. Ed.D. dissertation, Houston, Texas: University of Houston, 1975.
- Reburn, K. A Comparative Analysis of the Mathematics Used in Industry by Electronic Technicians Having an Associate Degree. Ph.D. dissertation, Greeley: University of Northern Colorado, 1971.
- Reinhart, B. Vocational-Technical Learning Materials: Books and Manuals for Schools and Community Colleges, Second Edition. Columbus, Ohio: The National Center for Research in Vocational Education, 1974. (ED 092 773)
- Rhine, S.H. Technician Education - Who Chooses It? New York, New York: Conference Board, Inc., 1972. (ED 080 744)
- \_\_\_\_\_ and Creamer, D. The Technical Manpower Shortage: How Acute? Oak Brook, Illinois: National Industrial Conference Board, Inc., 1969.
- Richardson, W.B. Cost-Benefit Analysis of Vocational Technical Education Programs in Missouri Junior Colleges. Ph.D. dissertation, Columbia: University of Missouri, 1972.
- Riverside Research Institute. The Coordination of Program Planning and Evaluation Systems for Occupational Education. The Development and Implementation of the Reporting and Evaluation System for Occupational Education. New York, New York: Riverside Research Institute, 1974. (ED 105 120)
- Rothwell, W.B. The Relationship of Certain Predictive Factors Including Personality Traits to Job Success of Graduates of Stenographic and Secretarial Programs of Public Supported Technical Institutes and Junior Colleges in the State of Alabama. Ed.D. dissertation, Auburn, Alabama: Auburn University, 1970.

### OUTLINE OF INSTRUCTION

c. A properly positioned wire on a tab terminal. Wire does not have to enter vertically to the mounting surface on tab style terminals in that the preferred 18 degree wrap is being used.

d. Wire position requirements for for double or multiple wires on hook terminals are the same as for single wire connections with the following additional requirements.

- (1) The wires wrap around the terminal in alternating directions. This equalizes stresses and protects the glass seal at the base of the terminal from damage.

### INSTRUCTOR ACTIVITY

c. Display Slide YXH L9-S11  
Stress this point.

d. Display Slide YXH L9-S12

### STUDENT ACTIVITY

463

893

South Carolina State Advisory Council. The Adequacy of Vocational and Technical Education. The Report of a Special Study. Columbia: South Carolina State Advisory Council on Vocational and Technical Education, 1976. (ED 126 315)

Staples, J.R. Responsibility for Technical Curricula in Arizona Junior Colleges. Ed.D. dissertation, Tempe: Arizona State University, 1970.

Statewide Inventory of Current and Intended Programs at Illinois Public Community Colleges. Springfield: Illinois Community College Board, 1976. (ED 135 422)

Stegeman, G.L.; Wagner, D.J.; and Anderson, R.H. Assessment and Determination of Basic Competencies Necessary for Utility Operators Using Ground Water Sources Part 1. Fennimore: Southwest Wisconsin Vocational-Technical Institute, 1975. (ED 113 589)

Stevens, D.W. Employment Projections for Planning Vocational-Technical Education Curricula: Mission Impossible? Columbia: University of Missouri, College of Education, Department of Practical Arts Vocational-Technical Education, Office of Vocational Education Research, 1976. (ED 136 014)

Stoehr, K. et al. Airframe and Powerplant Mechanics Curriculum Study. Final Report. Kenosha, Wisconsin: Gateway Technical Institute, 1976a. (ED 133 016)

\_\_\_\_\_. Research of Curriculum Content, Data Processing Program. Kenosha, Wisconsin: Gateway Technical Institute, 1976b. (ED 134 250)

Storm, G. "State of the Art." In-Service Technical Upgrading of Post-Secondary Vocational-Technical Instructors. Big Rapids, Michigan: Ferris State College, 1976.

\_\_\_\_\_. "The Scope of Technical Upgrading - Technical Upgrading of Occupational Instructors." American Technical Education Association, Inc. Journal. 5 (January-February, 1978): 10-12.

Stuart, W.R. Analysis of Two Year Engineering Technology Curricula on the Basis of Employer and Employee Experiences. Ed.D. dissertation, Buffalo: State University of New York, 1972.



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(2) All wires approach the terminal from the same direction (angle)

(3) The wires normally attach side side-by-side on the terminal. If the terminal size, wire size, or number of wires dictate, a piggyback (one wire directly on top of another) mounting style is permissible but care must be taken to adjust the diameter of wire bends accordingly.

e. Method of holding wires for hook and tab terminals in the proper soldering position.

3. Area to be soldered

(3) Stress side by side or piggy back technique.

e. Display Slide YXH L9-S13

3. Display Slide YXH L9-S14

"U.S. Business - Trends That Shape The Future." U.S. News and World Report. 84(February 13, 1978): 65.

U.S. Department of Health, Education, and Welfare, Office of Education. Agricultural Equipment Technology: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1970. (ED 038 527)

\_\_\_\_\_. Architectural and Building Construction Technology: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1969. (ED 038 527)

\_\_\_\_\_. Civil Technology and Structural Options: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1969. (ED 012 338)

\_\_\_\_\_. Criteria for Technician Education: A Suggested Guide. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1968. (ED 027 417)

\_\_\_\_\_. Farm Crop Production Technology: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1970. (ED 039 346)

\_\_\_\_\_. Forest Technology: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1968. (ED 021 063)

\_\_\_\_\_. Grain, Feed, Seed, and Farm Supply Technology: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1968. (ED 029 961)

\_\_\_\_\_. Mechanical Technology Design and Production: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1969.

\_\_\_\_\_. Metallurgical Technology: A Suggested Two-Year Post-High School Curriculum. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1968. (ED 037 565)

\_\_\_\_\_. Ornamental Horticulture Technology: A Suggested Two-Year Post-High School Curriculum, Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1970.

### OUTLINE OF INSTRUCTION

a. The area to be soldered consists of the portion of the terminal and wire that are in contact with each other.

b. Smooth fillets must be formed between the wire and terminal at all areas of contact.

c. There must be no copper exposed on the cut end of the wire.

#### 4. Solder quantity

a. Solder fillets must be formed at all points of contact between the wire and the lead and all fillets must be concave.

### INSTRUCTOR ACTIVITY

a. Stress

### STUDENT ACTIVITY

465

887

- Veterans Administration. Completion Rates for Education and Training Under the Vietnam Era GI Bill. A Study submitted to the Committee on Veterans Affairs, United States Senate, 94th Congress, 2nd Session. Senate Committee Print No. 48. Washington, D.C.: Veterans Administration, 1976a. (ED 139 917)
- \_\_\_\_\_. Training by Correspondence Under the GI Bill (An In-Depth Analysis). A study submitted to the Committee on Veteran's Affairs, United States Senate, 94th Congress, 2nd Session. Senate Committee Print No. 49. Washington, D.C.: Veterans Administration, 1976b. (ED 135 977)
- Ward, C.F. The State of Accreditation and Evaluation of Postsecondary Occupational Education in the United States. Raleigh: North Carolina State University, Center for Occupational Education, 1970. (ED 052 364)
- Watkins, D. et al. Chemical Technician Manpower Survey: State of Alabama. University: The University of Alabama, Institute of Higher Education Research and Services, 1973. (ED 081 604)
- Webb, R.S.A. A Comparative Profile of Daytime and Evening Enrollees in Electronics Technology Courses in Community Colleges in the San Jose, California Job Market. Ph.D. dissertation, Los Angeles: University of California, 1971.
- Welch, F.G. Cooperative Education: A Review. Columbus, Ohio: ERIC Clearinghouse on Adult, Career, and Vocational Education, 1977. (ED 149 185)
- \_\_\_\_\_. and Farmer, E.I. Assessment of Academic Credits for Cooperative Work Experience: A National Survey Concerning Two-Year Colleges and Universities. University Park: The Pennsylvania State University, 1977.
- Whitehead, C.O. Personal letter to Charles Doty. May 24, 1978.
- Wiggle, F.A. The Analysis of Personal Characteristics of Students in Four Distinctly Different Post-Secondary Institutions. Ph.D. dissertation, Auburn, Alabama: Auburn University, 1977.
- Willett, L.H. and Piland, W.E. Employer Evaluation of Occupational Programs. Presentation at the American Education Research Association, Ann Arbor, Michigan, July, 1973. (ED 078 819)

- | <u>OUTLINE OF INSTRUCTION</u>  | <u>INSTRUCTOR ACTIVITY</u> | <u>STUDENT ACTIVITY</u> |
|--|----------------------------|-------------------------|
| <p>b. There must be no excessive solder flow to other areas of the terminal.</p> <p>c. Solder quantity must be such that contours of wire and individual wire strands are clearly visible.</p> <p>E. Tools used to make hook and tab solder connections.</p> <p>1. Handtools</p> |                            |                         |

1. Remind students that tools are the same as used previously.

SUPPLEMENTAL LIST OF REFERENCES, 1979

- Appel, Victor H. and Roueche, John E. Installation and Assimilation of Educational Innovations in Vocational/Technical Programs in Post-Secondary Institutions. Final Report. Austin: University of Texas, Department of Educational Psychology, 1978. (ED 162 711)
- Busha, Charles H. The Conduct of Needs Assessments Among Employers: A Manual of Techniques and Interpretations for Business/Industry Surveys. Pendleton, South Carolina: Tri-County Technical College, 1979. (ED 176 810)
- Cooper, Richard V.L. Youth Labor Markets and the Military. The Rand Paper Series. Santa Monica, California: Rand Corporation, 1978. (ED 163 199)
- Dilts, Harold E. A Study of Current and Potential Cooperation in Vocational-Technical Education between Area Schools and Public Schools in Iowa. Iowa City: University of Iowa, College of Education, 1978. (ED 170 552)
- Doty, Charles R. How to Recognize a Quality Technical Education Program. Paper presented at the Convention of the American Technical Association, Los Angeles, California, March, 1979. (ED 176 842)
- Drummond, Darl E. The Minority Recruitment Program for Wisconsin VTAE System. Final Report. Madison: University of Wisconsin, Wisconsin Vocational Studies Center, 1978. (ED 164 842)
- Dziech, Billie. The Role of the Humanities in Vocational and Technological Programs. Paper presented at the Annual Convention of the American Association of Community and Junior Colleges, Chicago, Illinois, April 29-May 2, 1979. (ED 175 506)
- Hull, Daniel M. A Dissemination Model for New Technical Education Programs. Final Report. Waco, Texas: Technical Education Research Center, 1978. (ED 166 431)
- In Perspective. Colombo Plan Staff College for Technician Education: First Two Years. Singapore: Colombo Plan Staff College, 1978. (ED 170 450)
- Ives, Quay D. Laboratory Characteristics in Technical Education. Pomona: California State Polytechnic University, 1975. (ED 177 009)

OUTLINE OF INSTRUCTION

F. Techniques for making high quality hook and tab solder connections.

1. Application of flux

- a. Flux contained within the solder is normally sufficient for soldering a properly cleaned and prepared connection.
- b. External flux may be used if desired however, its use greatly increases chances of solder wicking up under the insulation.

INSTRUCTOR ACTIVITY

F. Display Slide YXH\_L9-S15

STUDENT ACTIVITY

467

897

897

Stone, Joics. The Engineering Technologist as Viewed by Employers and Educators: An Analytical Survey. Pomona: California State Polytechnic University, 1975. (ED 177 008)

A Study of the Administration, Operation, and Program Services of Vocational-Technical Education. Executive Summary. Washington, D.C. National Advisory Council on Vocational Education, 1978. (ED 174 812)

A Study of the Administration, Operation, and Program Services of Vocational-Technical Education. Full Report. Washington, D.C.: National Advisory Council on Vocational Education, 1978. (ED 174 811)

A Study of the Administration and Operation of Vocational Technical Education Programs. (Interim Bureau of Occupational and Adult Education Report). Washington, D.C.: National Advisory Council on Vocational Education, 1977. (ED 176 070)

Vocational and Technical Education. Annual Report, 1976-77. Minneapolis: University of Minnesota, Department of Vocational and Technical Education, 1977. (ED 159 371)

White, Robert H., ed. Evaluation Digest. An Evaluation Report of Vocational Education and Technical Education in South Carolina for Fiscal Year 1978. Columbia: South Carolina State Advisory Council on Vocational and Technical Education, 1979. (ED 171 927)



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

2. Proper heat

- a. Proper heating source is determined by choosing a tip size and element wattage appropriate to the mass being soldered. Use the variable power control to set temperature at the desired level.
- b. Proper heat flow is established by using a clean, dry iron and forming a heat bridge.

3. Application of solder

- a. For proper application of solder, bring a clean, dry iron into contact with the terminal and the wire.

OUTLINE OF INSTRUCTION

- b. The iron in proper contact to both the terminal and the wire and the heat bridge being established at the junction of the iron and the wire.

- c. Method of establishing a heat bridge on terminals with more than one wire attached.

- (1) Alternating direction of the wire wrap.

INSTRUCTOR ACTIVITY

- b. Display Slide YXH L9-S16

NOTE: The iron tip aids in maintaining wire position.

- c. Display Slide YXH L9-S17

1. Stress

STUDENT ACTIVITY

467

895

894

OUTLINE OF INSTRUCTION

(2) All wires approach terminal from the same direction and attach to terminal side-by-side.

(3) Caution must be used not to misalign wire position with soldering iron tip.

d. The proper method of applying solder to a single wire connection

(1) First, tin-cut end thoroughly

(2) Flow in sufficient solder to form fillets. Note that a very small amount of solder is required to complete this type connection.

INSTRUCTOR ACTIVITY

(2) Stress

(3) Stress

d. Display Slide YXH L9-S18

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

(3) Remove iron and solder at the SAME time.

e. Proper method of applying solder to a multiple wire connection.

(1) First, tin cut ends of ALL cut wires in the connection (on piggyback style, capillary action will tin hidden end).

(2) Add sufficient solder to form fillets.

(3) Remove iron and solder at the SAME time.

INSTRUCTOR ACTIVITY

e. Display Slide YXH L9-S19

STUDENT ACTIVITY

471

893

893

OUTLINE OF INSTRUCTION

4. Cleaning after soldering.

a. Thorough cleaning after soldering is always required.

b. Cleanliness must also be practiced during soldering.

G. Inspecting completed hook and eyelet terminal solder connections for quality.

1. Standards of acceptance

INSTRUCTOR ACTIVITY

a. Display Slide YXH L9-520

b. Display Slide YXH L9-521  
Note the grossly exaggerated example of poor soldering.

STUDENT ACTIVITY

900

3-2-27

901

472

OUTLINE OF INSTRUCTION

a. Typical hook and tab connection.

(1) The correctness of insulation clearance (hook and eyelet terminals use the same insulation clearance as turret terminals)

(2) Wire wrap (greater than preferred)

(3) Solder fillets

(4) Wire entry angle

INSTRUCTOR ACTIVITY

a. Display Slide YXH L9-522

(1) Stress all points

STUDENT ACTIVITY

473

913

912

OUTLINE OF INSTRUCTION

2. Indications

a. Single wire hook terminals



(1) Smooth, gleaming with no pits

(2) Concave solder fillets in proper places.

(3) Bare wire outside of solder connection remains flexible.

(4) No bare copper showing

904

INSTRUCTOR ACTIVITY

2. Display Slide YXH L9-S23

a. Stress below points

STUDENT ACTIVITY

905

474

OUTLINE OF INSTRUCTION

(5) Proper wire wrap

(6) Wire and strand contours visible

(7) Proper insulation clearance

b. Multiple wire hook terminals.

(1) Multiple wire connections are inspected for all points given for single wire connections.

(2) Alternating direction of wire wraps.

INSTRUCTOR ACTIVITY

b. Display Slide YXH L9-S24

(1) Stress

STUDENT ACTIVITY

495

906

3-2-30



### OUTLINE OF INSTRUCTION

c. Completed tab terminal connection which is inspected for the same points as the hook terminal connections.

d. Pierced tab style connection.

### 3. Reasons for rejection.

a. Wire damage in any manner

b. Solder sicking up wire and under insulation.

### INSTRUCTOR ACTIVITY

c. Display Slide YHX L9-S25

d. Display Slide YHX L9-S26  
It is also inspected for the same points as for hook terminal connections.

3. Stress reasons for rejection.

### STUDENT ACTIVITY

OUT. LINE OF INSTRUCTION

- c. Improper solder quantity
- d. Poor wetting action
- e. Improper wire positioning and wrap
- f. Any copper showing

H. Safety precautions

INSTRUCTOR ACTIVITY

- H. Display Slide YXH L9-S27  
Mention the precautions are the same as previously presented and that they should be observed throughout the course.

STUDENT ACTIVITY

477

911

910

3-2-32

OUTLINE OF INSTRUCTION

1. Workpiece

a. Same

2. Tool

a. Same

3. Personal

a. Beware of the poisonous fumes from  
Telfon during the stripping and  
soldering operations.

INSTRUCTOR ACTIVITY

3. Stress this point

STUDENT ACTIVITY

---

OUTLINE OF INSTRUCTIONINSTRUCTOR'S ACTIVITYSTUDENT'S ACTIVITY  
479

## I. Demonstration

1. Hook and Pierced Tab  
Terminal Soldering

1. Instructor should demonstrate the accepted techniques and use of the proper tools while connecting wires to Hook and Pierced Tab Terminals by soldering. Both single and double connections should be demonstrated. Introduce Performance Sheet 3-2-1P.

1. Observe demonstration and ask questions as necessary.

914

915

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>III. <u>APPLICATION</u></p> <p>A. Performance Sheet 3.2.1P</p>	<p>A. Supervise each student's completion of Performance Sheet --, emphasizing safety.</p>	<p>A. Complete performance Sheet 3.2.1. Ask questions if procedure are not clear.</p>
<p>IV. <u>SUMMARY</u></p> <p>A. Introduction</p> <p>1. Nature of Summary</p> <p>2. Purpose of Summary</p> <p>B. Directions to Students</p>	<p>A. Emphasize importance of the summary for the student.</p>	

916

916

OUTLINE OF INSTRUCTION

1. Questions

2. Notes

C. Recap of lesson is conducted during demonstration by instructor

V. INFORMAL TEST

A. There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application".

INSTRUCTOR ACTIVITY

C. Emphasize safety

STUDENT ACTIVITY

C. Ask questions if mate not clear; check note to insure accuracy and completeness.

481

918

OUTLINE OF INSTRUCTION

VI. ASSIGNMENT

A. Notetaking Sheet 3.2.1N

INSTRUCTOR ACTIVITY

A. Provide student with the homework assignment.

STUDENT ACTIVITY

A. Ask questions if the assignment is unclear. Complete assignment by reading and studying 3.2.1N.

920

3-2-36

921

482

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

Lesson Topic 3.3:  
Soldering to Bifurcated Terminals

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 1.75 Hours  
Laboratory - 5.5 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

a. MERP/2M Kit

2. Training Aids

a. Slides

(1) YXH L-10-S1 through YXH-L10-S34

3. Training Aids Equipment

a. Projector, slide

b. Screen, Projector, standard

4. Text

a. Student's Guide

5. References

a. MIL-STD-454D

1943-44P6

b. MIL-S-45743C

c. NHB 5300.4(3A)

TERMINAL OBJECTIVES

Supported partially by this lesson topic:

5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4(3A)

ENABLING OBJECTIVES

When you complete this lesson topic you will be able to:

3.3.1 PREPARE bifurcated terminals for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.

3.3.2 PREPARE wires for soldering by tinning and bending following the procedures and to the standard outlined in MIL-S-45743C.

3.3.3 CONNECT prepared wires to bifurcated terminals using the proper tools and soldering technique following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4(3A).

3-3-1



### CRITERION TEST

The student will be required to perform a minimum of one connection on each bifurcated terminal, completing the single entry, double entry, top entry and bottom entry connections using the soldering techniques as outlined in Performance sheet 3.3.1P and to the standards in MIL-STD-454D and MIL-S-45743C.

### HOMEWORK

Read and study Notetaking Sheet 3-3-1N.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>I. <u>INTRODUCTION</u></p> <p>A. Contact</p>	<p>A. Introduce self and topic. Provide for student needs:</p>	
	<p>1. Muster</p> <p>2. Comfort</p> <p>3. Visibility and seating</p>	
<p>B. Readiness</p>	<p>B. Explain value of subject matter, pointing out where appropriate, its relationship to the following:</p>	
<p>5402-03P8      925</p>	<p>3-3-3</p>	<p>926</p>

485

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

98h

1. Accomplishment of daily tasks aboard ship
2. The necessity of the skills and techniques in repair of printed circuit boards
3. Personal applications of the knowledge and skills. Seek to motivate. Tell a good tie-in story if possible.

C. Effect

C: When following a subject matter lesson topic, do the following:

928

OUTLINE OF INSTRUCTION

D. Overview

929

INSTRUCTOR ACTIVITY

1. Explain relationship of this lesson to previous lesson(s).
2. Commend students for mastery of skills in previous lesson(s).

D. Overview lesson by:

1. Stating learning objectives as contained on cover pages to this topic.
2. Stating procedures to be followed during the lesson.

3-3-5

STUDENT ACTIVITY

487

930

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>IV. <u>PRESENTATION</u></p> <p>A. Types, sizes and usage of bifurcated terminals</p>	<p>a. Taking notes</p> <p>b. Asking questions</p>	
	<p>c. Use of criterion test</p> <p>3. Invite questions concerning objectives and procedures.</p> <p>A. Explain type, size and usage of bifurcated terminals.</p>	<p>3. Ask questions concern objectives or procedures if in doubt</p> <p>A. Take notes. Ask questions.</p>

488

932

OUTLINE OF INSTRUCTION

1. Common types and sizes

a. Types - Variety of terminals of the bifurcated type (any terminal which has a split or a fork).

b. Sizes

(1) Many sizes are used depending on the current-flow requirements.

2. Uses

INSTRUCTOR ACTIVITY

b. Display Slide YXH L10-S2

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

a. Bifurcated terminals are used  
to solder many wires to a single  
point

b. High stress and current flow

B. Preparing bifurcated terminals for  
soldering

1. Cleaning

a. Terminals must be cleaned prior  
to attaching leads or conductors

INSTRUCTOR ACTIVITY

B. Display Slide YXH L10-S3

STUDENT ACTIVITY

Obh

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(1) Adding new solder and removing excess.

(2) On new, untarnished terminals the use of solvent alone for cleaning is often sufficient.

b. If terminals are handled during joint preparation, they must be recleaned with solvent.

2. Tinning

a. Used or tarnished terminals should always be tinned prior to soldering.



OUTLINE OF INSTRUCTION

- b. The tinning process enhances solder flow on the connection and clears oxides from the terminal.

C. Preparing wire for soldering to bifurcated terminals

1. Tools used

- a. Mechanical and/or thermal wire strippers

- b. Soldering iron

- c. Antiwicking devices

INSTRUCTOR ACTIVITY

C. Display Slide YXH L10-S4

- 1. Introduce only new tools to students

STUDENT ACTIVITY

ebh

9.10

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

d. Vice

e. Round nose pliers

f. Needle nose pliers

g. Orange wood stick

h. Flush-cutting pliers

2. Stripping - same techniques and procedures as taught for wire preparation when soldering turret terminals.

OUTLINE OF INSTRUCTION

3. Tinning - same techniques and procedures as those taught for wire preparation when soldering turret terminals

4. Bending

a. Any method may be used for bending wire that does not damage the wire in any way

(1) Needle nose pliers

(2) Nylon rod

(3) Dummy terminal

INSTRUCTOR ACTIVITY

a. Explain bending techniques

STUDENT ACTIVITY

h6h

344

913

OUTLINE OF INSTRUCTION

- b. Care must be taken not to crush, overstress or birdcage the wire during the bending operation

D. Bifurcated terminal solder connection specifications

1. Wire wrap

- a. Three different wire wrap specifications to be considered in bifurcated terminal connections.

- (1) Wire wrap for side entry connections shall be exactly 90 degrees

INSTRUCTOR ACTIVITY

- b. Stress this

D. Explain specifications

- (1) Display Slide YXH L10-S5

STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

(2) Wire bent to 90 degrees and is cut with flush-cutting pliers. The sharp square bend is made using flat-jawed pliers such as needle nose.

(3) Alternate method - sharp 90 degree bend using a dummy terminal

(4) Wire is bent and properly cut for making a side entry bifurcated terminal connection

b. Bottom entry wire wrap

### INSTRUCTOR ACTIVITY

(2) Display Slide YXH L10-S6

(3) Display Slide YXH L10-S7

(4) Display Slide YXH L10-SB

### STUDENT ACTIVITY

496

944

### OUTLINE OF INSTRUCTION

- (1) The only practical method of bending the wire for a bottom entry connection is by using the terminal as a bending form, since a bent wire cannot be inserted through the bottom of the terminal
- (2) The bend for this connection must be exactly 90 degrees; however, it is not necessary to make the corner of the bend as sharp as for a side entry
- (3) The wire for the bottom entry connection is cut flush with the edge of the terminal base. The same is true for the side entry connection.

949

### INSTRUCTOR ACTIVITY

- (1) Display Slide UXH L10-S9

- (3) Display Slide YXH L10-S10

3-3-15

### STUDENT ACTIVITY

497

959

ED193527

MEASURING CAREER EDUCATION OBJECTIVES:  
CURRENT STATUS AND FUTURE DIRECTIONS

written by

Anita Mitchell  
Southwest Regional Laboratory  
for  
Educational Research and Development  
Los Alamitos, California

The ERIC Clearinghouse on Adult, Career, and Vocational Education  
The National Center for Research in Vocational Education  
The Ohio State University  
1960 Kenny Road  
Columbus, Ohio 43210

1980

U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

CE 027090

OUTLINE OF INSTRUCTION

## c. Top entry connection

- (1) The wire in a top entry connection is not wrapped but, if smaller than the space between the terminal ears, is pressed in with a filler wire of the correct size to provide a snug fit between the ears.
- (2) The bottom end of the filler wire must be even with the surface of the base, and the top must be cut flush with the top edge of the terminal ears.
- (3) Great care must be used when cutting the filler wire not to cause damage to the wire being brought into the terminal

INSTRUCTOR ACTIVITY

- (1) Display Slide YXH L10-S11

- (2) Display Slide YXH L10-S12

STUDENT ACTIVITY

498

952



## FUNDING INFORMATION

Project Title: ERIC Clearinghouse on Adult, Career, and Vocational Education

Contract Number: NIE-C-400-76-0122

Educational Act Under Which the Funds were Administered: 41 USC 252 (15) and PL 92-318

Source of Contract: U.S. Department of Education  
National Institute of Education  
Washington, D.C.

Contractor: The National Center for Research in Vocational Education  
The Ohio State University  
Columbus, Ohio

Executive Director: Robert E. Taylor

Project Director: Juliet V. Miller

Disclaimer: This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Education. Contractors undertaking such projects under government sponsorship are encouraged to freely express their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official National Institute of Education position or policy.

Discrimination Prohibited: Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance."  
Title IX of the Education Amendments of 1972 states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal assistance." The ERIC Clearinghouse project, like every program or activity receiving financial assistance from the U.S. Department of Education, must comply with these laws.



This publication was prepared with funding from the National Institute of Education, U.S. Department of Education, under Contract No. NIE-C-400-75-0122. The opinions expressed in this report do not necessarily reflect the position or policies of NIE or the Department of Education.

OUTLINE OF INSTRUCTION

2. Wire position

a. The side entry single wire connection positioning specifications.

(1) The wire is in contact with the surface of the terminal base as seen from front and side views

(2) The wire wraps around one ear of the terminal and is in contact with the inside edge and one side of that ear

(3) The wire end is flush-cut and does NOT overhang the edge of the terminal

INSTRUCTOR ACTIVITY

a. Display Slide, YXH L10-S13

STUDENT ACTIVITY

## ABSTRACT

This paper explores the issue of establishing and evaluating objectives for local career education programs. It presents a perspective on the state of the art based on reviews of the literature. Although it is addressed principally to local program developers and managers, the paper is also aimed at state career education coordinators. After a discussion of career education objectives and legislation that has affected both state and local career education programs, the ten learner goals established by the United States Office of Career Education are examined at length. These are (1) competence in basic skills; (2) good work habits; (3) personally meaningful work habits; (4) career decision-making skills; (5) occupational and interpersonal skills; (6) understanding self and educational/vocational opportunities; (7) awareness of continuing and recurrent education; (8) consistence of placement with career decisions; (9) seeking meaning through work and leisure; and (10) awareness of methods of expanding career options. For each goal current status of research and evaluation is discussed and future needs are suggested. Recommendations are made, such as the need for increasing the quality of evaluation designs and measurement instruments. (CT)

DISC.: \*Community Programs; \*Career Education; Career Awareness; Employment Opportunities; Decision Making Skills; Job Placement; Job Skills; Behavioral Objectives; \*Program Development; Self Concept; \*State Programs; \*Program Evaluation; \*Educational Objectives; Competence; Basic Skills; Interpersonal Competence

IDEN.: United States; \*Office of Career Education

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>b. The side entry multiple wire connection has the same positioning as the single wire side entry with the following additional requirements:</p>	<p>b. Display Slide YXH L10-S14 and explain double wire positioning</p>	
<p>(1) Additional wires are wrapped in an alternating pattern.</p>		
<p>(2) Wires other than the bottom wire must contact the terminal bar as specified for single connections but will not contact the terminal base.</p>		
<p>(3) All wires enter the terminal from the same side and must be parallel to each other.</p>		

500

955

LEARNER GOAL VII: AWARE OF CONTINUING AND RECURRENT EDUCATION	19
CURRENT STATUS	19
FUTURE NEEDS	19
LEARNER GOAL VIII: PLACEMENT CONSISTENT WITH CAREER DECISIONS	20
CURRENT STATUS	20
FUTURE NEEDS	20
LEARNER GOAL IX: SEEKING MEANING THROUGH WORK AND LEISURE	22
CURRENT STATUS	22
FUTURE NEEDS	22
LEARNER GOAL X: AWARE OF METHODS OF EXPANDING CAREER OPTIONS	23
CURRENT STATUS	23
FUTURE NEEDS	23
SUMMARY	24
FUTURE NEEDS	25
REFERENCES	26

OUTLINE OF INSTRUCTION

c. The bottom entry connection positioning specifications.

(1) The wire must be in contact with the surface of the terminal base from the edge of the hole out to the edge of the base.

(2) The wire must be cut flush with the edge of the base and must not overhang.

(3) The wire should lie on a line drawn straight through the gap between the ears of the terminal

INSTRUCTOR ACTIVITY

c. Display Slide YXH L10-S15

STUDENT ACTIVITY

Evaluation efforts are discussed in this paper for two reasons: (1) the reader should not be left with the impression that only the thirteen JDRP-approved career education programs were adequately evaluated, and (2) the reader needs to be alerted to the fact that the cause of career education has been ill-served by inadequate evaluations of programs that probably deserve to be replicated. Where there is sufficient information to judge the adequacy of evaluation of the programs referenced, this information is presented.

#### CAREER EDUCATION OBJECTIVES

The genesis of career education has been outlined in many publications, but the development of career education objectives has not been well documented. In fact, a recent review of state plans for career education (Southwest Regional Laboratory, 1979) showed that, with the exception of those adopting the definition of career education developed by the Office of Career Education, there was considerable range in the concepts included in the term. In general, career education objectives at the state level tend to be limited in scope. Similar limitations are observed in review of evaluation reports of programs/projects at the local level.

As early as 1971, state departments of education began developing models for career development. By 1972, at least seven states (including Missouri, Wisconsin, Hawaii, and California) had published documents outlining desired student outcomes for career education, career guidance, and/or career development programs. The models had one major common aspect: although the terminology differed from state to state, all identified three components which related to knowledge of self, knowledge of the world of work, and career planning and decision-making skills. Within these components, each model suggested specific learner outcomes; these, too, revealed considerable similarity. As a matter of fact, there was considerable dialogue among the developers of these models and their consultants which did result in consistency of direction. States that had not developed their own models tended to review the existing models, note the similarities, and adopt or adapt them to meet their own needs. Local school districts intent upon joining the career education movement found the models appropriate for local programs. A review of the literature indicated that the three components of the state models still dominate state and local program objectives, and, therefore, are also the basis for state and local evaluations.

It is interesting to note that as early as 1974, Kenneth B. Hoyt, director of the Office of Career Education (OCE), United States Office of Education, suggested nine goals for career education.

OUTLINE OF INSTRUCTION

d. The top entry connection has the following positioning specifications.

(1) The cut end of the wire shall be level with the surface of the terminal base

(2) The wire shall be exactly in line with the hole through the base of the terminal

e. Insulation clearance for all styles of bifurcated terminal connections shall be the same as that given for previous terminals

INSTRUCTOR ACTIVITY

d. Display Slide YXH L10-S17

e. Explain area to be soldered

STUDENT ACTIVITY

502

969



they were assuming the role recommended in the many "how-to" guides (e.g., Young and Schuh, 1975; Mitchell, 1979) they were involved in the statement of the objectives. As a result of the limited focus, more and more evidence has been gathered of the efficacy of career education in areas such as career awareness, self-knowledge, and decision-making, while relatively less evidence is available in areas such as improvement of basic academic skills and work habits. Little or no evidence is available in such areas as means available for continuing or recurrent education, finding meaning in work and productive use of leisure time, or awareness of means for changing career options. Yet legislatures, business and industry, and the general public (on whom we as educators depend for support of our career education efforts), are most interested in results in those areas for which little evidence of effectiveness has been presented. Since the Office of Career Education, under the leadership of Kenneth B. Hoyt, has provided educators with a set of career education goals that could result in improvement in all of education, it is difficult to understand why the range of objectives in most career education programs remains relatively narrow.

#### LEGISLATION

Another source of objectives for both state and local career education programs is the career education legislation which includes some mandates and some parameters within which federal fund expenditures must operate. The Educational Amendments of 1974 (PL 93-380) provided funds for the development of state plans for career education. The law mandated that program objectives include provision for meeting the special needs of handicapped and other disadvantaged students and for eliminating the stereotyping of career opportunities by race or by sex. It also included the goal of preparing all students, including handicapped and all other children who are educationally disadvantaged, for full participation in the society in which they are to live and work. The goal of fostering flexibility in attitudes, skills, and knowledge in order to enable persons to cope with accelerated change and obsolescence also was mentioned.

PL 95-207 included mandates for the following goals: (1) making education as preparation for work and as a means of relating work values to other life roles (such as family life) a major goal of all who teach and all who learn; (2) promoting equal opportunity in making career choices through the elimination of bias and stereotyping, including bias and stereotyping on the basis of race, sex, age, economic status or handicap; and (3) presenting objectives for increasing career awareness, exploration, decision-making, and planning. PL 95-207 specified that payments

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>3. Area to be soldered</p> <p>a. The entire surface of the base must be tinned.</p> <p>b. Smooth fillets must be formed between the wire and the terminal at all areas of contact.</p> <p>c. There must be no copper showing on cut wire ends.</p> <p>d. In all cases, solder must be flowed entirely over the hole through the base of the terminal, but no solder may flow through the hole beyond the bottom edge of the terminal base.</p>		

## LEARNER GOAL I: COMPETENCE IN BASIC SKILLS

### CURRENT STATUS

Learner Goal I, "competence in the basic academic skills required for adaptability in our rapidly changing society," has been incorporated into the objectives of an estimated 5 to 8 percent of the career education programs or projects whose reports have become part of the ERIC data base. In most cases, it was one of a number of objectives rather than the primary objective of the studies. In other words, the projects appear to be based on the hypothesis that "if students increase their awareness of the relevance of academic studies to later success in work, then their performance in the basic skills will improve." In most cases the reports indicated that the "if" did occur, but that the "then" did not. This is possibly due to the fact that the project staff assumed a cause and effect relationship that does not necessarily exist. In other words, knowledge of relevance is not enough. This knowledge must be internalized, and the student must be motivated if improvement in academic performance is to occur. However, it is gratifying to find that there are programs that are attempting to measure the impact of career education on basic skills. Although there is evidence that career education can improve students' career awareness, one can still ask, "What difference does this make in the students' educational/occupational development?" Acquisition of basic academic skills certainly would be one important difference. At least four reviews of the impact of career education on the development of basic academic skills cite some successes in this area. Of thirty-eight studies reviewed by Bhaerman (1977) which reported efforts to affect academic achievement through career education, nineteen presented strong evidence of success, and sixteen presented moderate evidence. Three studies reported by Datta et al. (1977) showed gains in reading and mathematics among career education students. The New Educational Directions' report by Bonnet stated that data on career education's effect on academic skills were inconclusive, although significant gains were reported in some instances. The 1976 report of the National Advisory Council for Career Education (NACCE) on the impact of career education concluded that more hard data were needed to support the contention that career education can aid the development of students' acquisition of fundamental skills.

There are a few outstanding examples, however, of the impact of career education on basic skills. The career education program of the Jefferson County Schools in Louisville, Kentucky, judged by the American Institutes for Research to be one of the ten best evaluated career education activities for which evaluation reports were available for analysis in 1977, showed significant

OUTLINE OF INSTRUCTION

4. Solder quantity

a. All solder fillets must be concave.

b. There must be no solder on any portion of the terminal other than those given as areas to be soldered.

c. Contours of wires and individual strands must be visible.

E. Techniques for making high quality bifurcated terminal solder connections

INSTRUCTOR ACTIVITY

E. Display Slide YXH L10-S18

STUDENT ACTIVITY

504

904

## LEARNER GOAL II: GOOD WORK HABITS

### CURRENT STATUS

Learner Goal II, "equipped with good work habits," was found among the objectives of most projects that expected to show improvement in academic skills and in most experience-based career education (EBCE) programs. About 20 percent of the program/project reports reviewed included work habits among their objectives. However, since work habits were defined differently, it may be misleading to aggregate data claiming to prove that career education can improve the work habits of participants. Most of the projects used locally developed instruments to measure gains in this area. In many cases these instruments were nonvalidated questionnaires, opinionnaires, or observational techniques. Standardized instruments were used in only a few cases.

A third-party evaluation of the Exemplary Career Education Comprehensive Program in the Academic and the Vocational and Technical Education Program in Puerto Rico (Colon and Gonzalez, 1975) showed that in addition to improvement in self awareness, awareness of work values, awareness of and knowledge about work and decision-making skills, participants did gain significantly in basic academic/vocational skills and in work habits. Northwest Regional Educational Laboratory (Community Experiences for Career Education, Inc., 1974) reported statistically significant gains in study skills. Herron et al. (1973) reported that students in an experience-based program improved in work performance, adherence to work schedules, acceptance of responsibility, interest in and enthusiasm for work, judgment, ability to work with others, and ability to learn through work experience.

These are the only studies reviewed that used evaluation instruments, data collection procedures, and statistical analysis designs that lent credibility to the findings in the area of acquisition of work habits. It is unfortunate that so many of the projects reported concentrated on verification of process, with little or no measurement of outcome. Too often proof that a program has been installed is viewed as sufficient rationale for its continuation.

### FUTURE NEEDS

If we are to believe the literature that stresses the importance of work habits for successful job entry, maintenance, and advancement, then surely program managers need to focus on the development of this very important objective. Also, we need to

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>1. Application of flux</p> <p>a. Flux contained within the solder is normally sufficient for soldering a properly cleaned and prepared connection.</p> <p>b. External flux may be used if desired; however, its use greatly increases the chance of solder wicking up under the insulation.</p>		
<p>2. Proper heat</p> <p>a. Proper heating source is determined by choosing a tip size and element wattage appropriate to the mass being soldered. Use the variable power control to set temperature at the desired level.</p>		

- a. Flux contained within the solder is normally sufficient for soldering a properly cleaned and prepared connection.
- b. External flux may be used if desired; however, its use greatly increases the chance of solder wicking up under the insulation.

- a. Proper heating source is determined by choosing a tip size and element wattage appropriate to the mass being soldered. Use the variable power control to set temperature at the desired level.

## LEARNER GOAL III: PERSONALLY MEANINGFUL WORK HABITS

### CURRENT STATUS

Learner Goal III, "equipped with a personally meaningful set of work habits that foster in them a desire to work," has been addressed by only a small proportion of the projects reviewed. The New Educational Directions publication (1977) cited above, in its review of results of 1975-76 career education programs, confirmed that those projects which sought to instill values that foster a desire to work presented generally good evidence of success.

A report by McBain and McKay described the long-term Developmental Career Guidance Project in Pima County, Arizona. This project, judged one of the ten best evaluated career education projects at that time, was approved by the Joint Dissemination and Review Panel (JDRP), thereby making it eligible for national dissemination. McBain and McKay reported that students' attitudes toward school and work improved as a result of participation in the program. Baker and Lish (1978), reporting on another JDRP program, cited statistically significant gains in participants' economic awareness and attitudes toward work (as well as in career awareness and career decision making). Baker and Steinkaker (1978), reporting on Project MATCH, also recorded gains in attitudes toward work. Peck (1973) reported improved personal and work-oriented attitudes among students participating in the Career Development Exemplary Project in Washington, D.C. A 1976 program for gifted and talented students (Highline Public Schools, Seattle, Washington) found that participants felt more responsibility for their career futures than did nonparticipants.

### FUTURE NEEDS

Although these evaluation reports do support the claim that career education can contribute to improved attitudes toward work, a reexamination of the learner goal quoted at the beginning of this chapter revealed a far broader concept than is typically "objectified" or measured. Specific objectives in need of exploration include the following: Students will (1) determine how their interests, aptitudes, abilities, and values affect work values; (2) determine what work means to the individual; (3) determine how to achieve harmonious relationships between work and worker; (4) determine the satisfactions expected or wanted from a job; (5) embrace productivity as a basic psychological need; (6) value work as an outlet for one's inherited and developed talents; (7) be able to derive satisfaction from a

OUTLINE OF INSTRUCTION

- b. Proper heat flow is established by using a clean, dry iron and forming a heat bridge.

3. Application of solder

- a. For proper application of solder, bring a clean, dry iron into contact with the terminal and the wire.
- b. For each bifurcated terminal connection style, there is a separate technique for applying solder.
- c. The solder application technique for side entry connections with a single wire is as follows.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

505

4

995

967

3-3-24

0944-45P8



## LEARNER GOAL IV: CAREER DECISION-MAKING SKILLS

### CURRENT STATUS

Learner Goal IV, "equipped with career decision making skills, job hunting skills, and job seeking skills," has met with mixed interest among career educators whose programs/projects were reviewed. Whereas about one-third of them addressed career decision-making skills, few of them (except the EBCE programs) emphasized job hunting and job seeking skills. Again, we find that the terms are ambiguous with each serving as an umbrella for a large number of discrete skills that might become the focus of a program or program component. Also, most project reports used global, ambiguous terms, rather than defining the discrete skills they are trying to develop in project participants. There are some existing instruments in the area, and many of the programs did use these instruments.

The New Educational Directions, Inc. synthesis of career education evaluation findings (1977) supported the claim that career education programs can strengthen career decision-making skills. Baker and Lish's report of the project in Ceres, California (1978) and McBain and McKay's report of the Pima County, Arizona project (1978) both presented evidence of gain in this area as validated by the JDRP approval of their evaluation reports. Baker and Steinaker reported another JDRP-approved program which showed increases in decision-making skills - Project MATCH in Ontario-Montclair, California (1978). Two other JDRP-approved programs in Coloma, Michigan (Kaplan and Downey, 1978) and Akron, Ohio (McBain and Topougis, 1978) also showed gains in career decision-making skills. No learner goal other than understanding of educational-vocational opportunities has accrued as much evidence validated by the JDRP as has the area of career decision-making.

However, parts of this goal, the areas of job hunting and job getting skills, have been given little attention as objectives. Evidence of the effectiveness of career education in developing these skills is sparse. EBCE programs seem most likely to include objectives in this area, but their measures are usually participants' success in getting jobs. Since many factors other than the individuals' job hunting and job getting skills are involved, it is difficult to ascribe success or nonsuccess to the programs. In most cases there is no evidence of success. However, this may be due to lack of receptivity in the work community rather than lack of skill on the part of the job seeker. There are, however, a few programs that did show gains in some facets of job hunting and/or job getting. For example, McBain and McKay (1978) showed gains in employability skills

OUTLINE OF INSTRUCTION

(1) Establish the heat bridge  
for a side entry connection.

(2) Thoroughly tin the surface  
of the base of the terminal  
and the cut end of the wire.

(3) REMOVE THE IRON and CONTINUE  
to flow solder into the  
hole area of the terminal  
(using residual heat of  
terminal to melt solder)  
until the hole is completely  
covered with solder.

d. The solder application technique  
for multiple entry connections

INSTRUCTOR ACTIVITY

(1) Display Slide YXH L10-S19

(2) Display Slide YXH L10-S20.

(3) Explain this technique  
well, ensuring each  
student understands  
it. . . This will only  
work if the iron is  
removed and must be  
finished before the  
terminal cools below  
the solder melting  
point.

STUDENT ACTIVITY

habits, and knowledge of appropriate follow-up procedures. None of the studies reviewed included all of the concepts in its investigation. It would appear that there is a lack of definition of the specific skills related to this learner goal.

OUTLINE OF INSTRUCTION

(1) Establish the heat bridge for a multiple side entry connection

(2) Thoroughly tin the base of the terminal, remembering that there is more than one cut wire end to be tinned.

(3) Cover the hole area with solder again, using the same techniques used with single wire side entry connections.

e. The solder application technique for top entry connections

(1) Establish the heat bridge for a top entry connection

INSTRUCTOR ACTIVITY

(1) Display Slide YXH L10-S21

(2) Display Slide YXH L10-S22

(1) Display Slide YXH L10-S23

STUDENT ACTIVITY

972

971

with fellow workers and to support their efforts is basic to job success; and (4) job-specific skills include not only motor skills and ideational skills, but also academic skills and attitudinal skills.

OUTLINE OF INSTRUCTION

(2) The base is tinned as with previous connection styles

(3) Cover the hole again

f. The solder application technique for bottom entry connections is as follows.

(1) Establish the heat bridge for a bottom entry connection

(2) Tinning the base and forming the fillets for a bottom entry connection

INSTRUCTOR ACTIVITY

(3) Display Slide YXH L10-S24

(1) Slide YXH L10-S25

(2) Display Slide YXH L10-S26

STUDENT ACTIVITY

Career education programs which were approved by JDRP as presenting evidence of gains in the area of career awareness include Ontario-Montclair (Baker and Steinaker, 1978); Pima County (McBain and McKay, 1978); Ceres (Baker and Lish, 1978); Coloma (Kaplan and Downey, 1978); Highline Public Schools (1976); Maine's Project GIVE (1976); and South Carolina's middle school program (Matthews and O'Tuel, n.d.). Greenland, Arkansas' Project CAP, another JDRP approved program (Hamilton and Leffler, 1978), showed statistically significant gains in awareness of adult occupations among project participants.

#### FUTURE NEEDS

Review of these reports (only a few presented instruments used) leaves one wondering whether the career awareness being taught and measured really constitutes the "understanding of educational-vocational opportunities" which Learner Goal VI addresses. Perhaps there is too much emphasis on acquisition of facts about occupations and not enough emphasis on educational-vocational opportunities, including methods of expanding opportunities. It is important to note what emphasis is placed on concepts such as the following: (1) most persons could perform adequately and achieve satisfaction in a variety of occupations; (2) the unique self - the pattern of personal characteristics - is not static but is dynamic and has the inherent power to change with such change being imposed continuously through life experiences; (3) social class roles, sex, ethnicity, and other factors - both reversible and irreversible - affect career development; (4) an individual's self-concept determines how he or she reacts to and influences his or her environment; (5) occupational supply and demand affect career opportunities; (6) there is a relationship between technological advances and occupational demand; (7) economic and political forces create changes in employment opportunities; (8) utilizing the knowledge that occupations exist for society's purposes encourages the individual to become a force in shaping the society in which he or she lives instead of allowing his or her occupational life to be shaped by others; (9) all occupations have some disadvantages; and (10) job specialization can isolate the worker from the total activity and reduce the possibility for workers to see the results of their efforts.

The above concepts are suggested, not as bases for individual objectives, but as examples of the kinds of concepts that need to be sampled in order to ensure that students truly develop career awareness. Statistical data to be found in the Dictionary of Occupational Titles or the Occupational Outlook Handbook are of little value to the student if some of these more pertinent concepts are not understood and internalized.

OUTLINE OF INSTRUCTION

- (3) The hole is sealed with solder as in previous connection methods

4. Cleaning after soldering

- a. A thorough cleaning must be given the connection after soldering

- b. Cleaning is accomplished as described previously

- F. Inspecting completed bifurcated terminal solder connections for quality

INSTRUCTOR ACTIVITY

4. Display Slide YXH L10-S27

- a. Stress this point

- F. Display Slide YXH L10-S28  
"Inspecting Bifurcated Terminal Connections"

STUDENT ACTIVITY

S/O

975

973



## LEARNER GOAL VIII: PLACEMENT CONSISTENT WITH CAREER DECISIONS

### CURRENT STATUS

Learner Goal VIII, "either placed or actively seeking placement in a paid occupation, in further education, or in a vocation consistent with current career decisions," is another learner goal that is seldom addressed in reports of career education programs. Although some experience-based programs have placement as part of their strategies, few make placement a program objective. This is probably appropriate, since placement is dependent not only on the employability skills which can be delivered by the schools, but also on employment opportunities which exist at any given time in the community.

The Lincoln, Nebraska Career Education Project (Lincoln Public Schools, 1976) reported to have placed all of the students who had dropped out of school after the second or third quarters and who requested placement assistance. Placement activities were supported by the community resource system, but the report presented no evidence that the participants developed any skills to support their placement.

### FUTURE NEEDS

As is probably the case with Learner Goal VII, Learner Goal VIII is seen as an ongoing goal of counseling and guidance rather than as a specific career education goal. Therefore, it is not included in the objectives of career education programs. In many school districts, a majority of the students will be going on for further education or training beyond high school. Counselors assume the responsibility for making sure that they are ready for entry into the occupation or the training program of their choice. By not defining this guidance function as part of the career education program, school districts may be neglecting to evaluate its attainment. Perhaps many students are not reaching this goal.

Some of the concepts that may be overlooked if this goal is not included in the career education programs are the following: (1) persons "actively seeking placement" are those who have made at least an interim career decision consistent with their characteristics, who have developed and are using effective job seeking and job getting skills, and who are aggressively pursuing all leads; (2) alternative routes to continuing career development include working in a paid occupation, receiving additional education or training, and pursuing a vocation such

OUTLINE OF INSTRUCTION

1. Standards of acceptance

a. The following points must be examined and determined to be within specifications:

(1) Proper wire wraps

(2) Correct wire position

(3) Solder in all required areas

(4) Proper solder quantity

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

## LEARNER GOAL IX: SEEKING MEANING THROUGH WORK AND LEISURE

### CURRENT STATUS

Learner Goal IX, "actively seeking to find meaning and meaningfulness through work and productive use of leisure time," is another of the goals that has not found its way into local career education programs. Perhaps program managers interpret this to mean something that happens after students are out of school and on the job - hence, beyond the effects of the local career education program. However, unless students are taught the various meanings of work and productive use of leisure time, it is doubtful that these very important aspects of their lives will occur without months, or perhaps years, of floundering and dissatisfaction.

### FUTURE NEEDS

A number of concepts need to be included in a career education program to ensure attainment of this goal. These include the following: (1) finding meaning in work is dependent upon a decision concerning the part work is to play in total life satisfaction; (2) the meaningfulness of work is related to the individual's commitment to the goals of the company/agency/organization; (3) some jobs are not totally fulfilling for the worker, and satisfaction must be sought outside the job; (4) personal fulfillment is dependent upon the opportunity to find adequate outlets for one's abilities, interests, personality, and values; (5) there is a wide range in the degrees and kinds of satisfaction that are derived from work; (6) purpose and commitment play a part in the meanings people attach to work; (7) personal satisfaction in work is related in part to effective involvement in leisure time activities; and (8) leisure time activities include volunteerism, political advocacy, and philanthropic pursuits as well as social and athletic pursuits and personal development activities.

OUTLINE OF INSTRUCTION

(5) No solder defects

2. Indications to look for

a. Each style of bifurcated terminal has its own indications of quality

b. The indications for single wire side entry connections are as follows:

(1) Solder, smooth, and gleaming with no pits

979

INSTRUCTOR ACTIVITY

2. Explain what to look for in each bifurcated terminal connection, style.

(1) Display Slide YXH L10-S29  
Pass sample around class of each style of terminal

STUDENT ACTIVITY

512

959

## SUMMARY

It is interesting to note that the components of the state career education models developed in 1971 and 1972 - knowledge of self, knowledge of the world of work, and planning and decision-making skills - are well represented in the objectives of many of the programs whose evaluation reports were reviewed for this paper. However, the broader range of expected outcomes outlined in the OCE learner goals as early as 1974 have been addressed only sporadically. Emphasis has been on self-knowledge/awareness, occupational knowledge/awareness, and decision-making skills. Less focus was made in attempts to foster basic academic skills, good work habits, meaningful work values, interpersonal skills, alternate training routes, placement in education or training, the identification of meaning and meaningfulness in work and leisure activities, and awareness of means for changing career options.

It appears that, despite the encouragement provided by the Career Education Incentive Act (PL 95-207), most career education program/project staffs still tend to view career education quite narrowly instead of seeing it as a catalyst for improvement of education as a whole. Limiting objectives to those related to self-knowledge, knowledge of work, and decision-making skills relegates career education to program rather than to process status. An examination of the ten OCE learner goals shows that a career education program that incorporated all of these would, in fact, be an educational process involving all staff members and all curricular areas in delivery of basic concepts to students. As indicated, some of these goals traditionally have been seen as the domain of guidance. Since guidance must be an integral part of any career education program, the task is to specify the desired learner outcomes as part of the program and to enlist the support of the guidance staff in delivering these outcomes. It is important to accept the full range of goals and work toward their achievement to ensure the comprehensiveness of career education programs.

The ten learner goals used as organizers for this analysis have been validated by the Office of Career Education through a series of mini-conferences during which nearly 1000 individuals, representing educational institutions, parent groups, service organizations, youth groups, business and industry, labor, philanthropic organizations, and many other professional and lay groups were brought together to help define the goals and processes of career education. All agreed that the ten learner goals offer a reasonable and complete range of competencies every student should possess upon exit from school at any level.

OUTLINE OF INSTRUCTION

- (2) Concave solder fillets in proper places.
- (3) No solder wicking on wire
- (4) No copper showing
- (5) Wire wrap and positioning correct
- (6) Wire and strand contours visible
- (7) Hole completely filled over with solder

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

## REFERENCES

- Arizona State Department of Education. Summary Evaluation Report of Career Education in Southern Arizona. Tucson, Arizona: Behavioral Research Associates, 1975. (ED 118 755)
- Baker, O. and Lish, V. Project CERES. Palo Alto, California: American Institutes for Research, 1978. (ED 162 103)
- Baker, O. and Steinaker, N. Project MATCH. Palo Alto, California: American Institutes for Research, 1978. (ED 162 107)
- Bhaerman, R.D. Career Education and Basic Academic Achievement - A Descriptive Analysis of the Research. Washington, D.C.: U.S. Office of Education, Office of Career Education, 1977.
- Colon, J. and Gonzalez, J. Evaluation of the Exemplary Career Education Comprehensive Program in the Academic and the Vocational and Technical Education Program of Puerto Rico. Hato Rey: Puerto Rico State Department of Education, Psychological Services Corp., 1975. (ED 154 204)
- Community Experiences for Career Education, Inc. Final Evaluation Report of the NWREL Experience-Based Career Education Program. Washington, D.C.: National Institute of Education; Tigard, Oregon: Community Experiences for Career Education, 1974. (ED 117 301)
- Datta, L. et al. Career Education: What Proof Do We Have That It Works? Washington, D.C.: Office of Education, U.S. Government Printing Office, 1977. (ED 151 516)
- Enderlein, T.E. A Review of Career Education Evaluation Studies. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1977. (ED 141 584)
- Glur, J. Westside Area Career Occupations Project. Phoenix, Arizona: Arizona State Department of Education; Tucson, Arizona: Behavioral Research Associates, 1976. (ED 133 480)
- Haaby, G. The Tennessee Exemplary Project in Career Education, Final Report. Washington, D.C.: U.S. Office of Education; Greenville, Tennessee: Greenville City Schools, 1976. (ED 134 829)

OUTLINE OF INSTRUCTION

c. The indications for multiple wire side entry connections

(1) All the indications listed for single wire joint

(2) Additional wires alternating direction of wrap

(3) Smooth flows of solder forming fillets between wires and between additional wires and terminal ears.

d. The indications for completed top entry connections.

INSTRUCTOR ACTIVITY

c. Display Slide YXH L10-30

d. Display Slide YXH L10-S31

STUDENT ACTIVITY

514

984



Mitchell, A. et al. Evaluating Career Education: Some Practical Models. Salt Lake City, Utah: Olympus Press, 1979.

National Advisory Council for Career Education (NACCE), The Efficacy of Career Education. Washington, D.C.: U.S. Office of Education, U.S. Government Printing Office, 1976.  
(ED 130 092)

New Educational Directions. What Does Career Education Do For Kids? A Synthesis of 1975-76 Evaluation Results. Crawfordsville, Indiana: New Educational Directions, 1977.  
(ED 143 831)

Peck, H. Career Development Exemplary Project, Washington, D.C. Washington, D.C.: District of Columbia Public Schools, 1973.  
(ED 086 872)

Ryan, C. et al. Comprehensive Career Education Project, 1976-77. Orono: University of Maine, College of Education, 1977.  
(ED 166 398)

Southwest Regional Laboratory. Assessment of State Plans for Career Education. Final Report. Los Alamitos, California: Southwest Regional Laboratory, 1979. (ED 178735)

Young, M.B. and Schuh, R.G. Evaluation and Educational Decision-Making: A Functional Guide to Evaluating Career Education. Washington, D.C.: Development Associates, 1975.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
(1) Solder, smooth and gleaming with no pits.		
(2) Concave solder fillets in proper places.		
(3) No solder wicking on wire.		
(4) No copper showing.		
(5) Wire and strand contours visible.		
(6) Hole completely filled over the solder.		

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

51b

(7) Filler wire properly inserted.

e. The indications for completed bottom entry connections are:

(1) The same as those listed for single wire side entry connections

(2) Wire free inside shank of terminal

f. Insulation clearance must be checked. Clearance specifications are the same whenever insulated wire is used

f. Display Slide YXH L10-S32

985

### OUTLINE OF INSTRUCTION

- (1) Minimum - not imbedded in the solder joint
- (2) Maximum - no more than twice the diameter of the wire including the insulations

### 3. Reasons for rejection:

- a. Wire damaged in any manner.
- b. Solder wicking up wire.
- c. Improper solder quantity.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

d. Poor wetting action.

e. Improper wire wrap or positioning.

f. Improper soldered area.

g. Solder defects.

G. Safety precautions

INSTRUCTOR ACTIVITY

G. Stress that it is important  
that the safety precautions  
be observed at all times.

STUDENT ACTIVITY

518

932

## H. Demonstration

### 1. Soldering bifurcated terminals

### III. APPLICATION

### A. Performance Sheet

1. Instructor should demonstrate the proper technique and use of tools while showing the students how to solder bifurcated terminals as covered during the lesson.

A. Supervise each student's completion of performance sheet. Emphasize safety.

### STUDENT ACTIVITY

1. Observe and ask questions if necessary

A. Complete performance sheet. Ask question: if procedures are not clear.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
IV. <u>SUMMARY</u>		
A. Introduction	A. Emphasize importance of the summary for the student.	
1. Nature of summary		
2. Purpose of summary		
B. Directions to students		
1. Questions		
2. Notes		

520

513

995

### OUTLINE OF INSTRUCTION

### C. Recap of lesson

1. Lesson is completely summarized during demonstration by instructor.

## V. INFORMAL TEST

A. There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application".

## VI. ASSIGNMENT

A. Read and study 3-3-1N.

### INSTRUCTOR ACTIVITY

### C. Emphasize safety

A. Provide students with the homework assignment.

### STUDENT ACTIVITY

C. Ask questions if material not clear; check notes to insure accuracy and completeness

A. Ask questions if the assignment is unclear.  
Complete assignment.



FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

Security Classification: UNCLASSIFIED

Lesson Topic 3.4:  
Soldering Connector Pins

Time Allocation: Classroom - 1.75 Hours  
Laboratory - 5.75 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides

(1) YXH L11-S1 through YXH-L11-S20

3. Training Aids Equipment

- a. Slide Projector  
b. Screen, Projector, Standard

4. Text

- a. Student's Guide

5. References

- a. MIL-STD-454D  
b. MIL-S-4573C  
c. NHB 5300.4 (3A)

TERMINAL OBJECTIVES

Supported partially by this lesson topic:

- 5.0 CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connector pins using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4 (3A).

ENABLING OBJECTIVES

When you complete this lesson, you will be able to:

- 3.4.1 PREPARE connector pins for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.  
3.4.2 PREPARE wires for soldering by stripping and tinning following the procedures and to the standards outlined in MIL-S-45743C.  
3.4.3 CONNECT prepared wires to connector pins using the proper tools and soldering techniques following the procedures and to the standard outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4 (3A).

### CRITERION TEST

The student will be required to perform a minimum four connections to connector pins using the soldering techniques as outlined in Performance Sheet 3-4-1P and to the standards in MIL-STD-454D and MIL-S-45743C.

### HOMEWORK

Complete assignment sheet 3-4-1A

10.1

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
I. <u>INTRODUCTION</u> A. <u>Contact</u>	A. Introduce self and topic. Provide for students needs:	
6	1. Muster  2. Comfort  3. Visibility and seating	
B. <u>Readiness</u>	B. Explain value of subject matter, pointing out where appropriate, its relationship to the following:	

0554-55P10

3-4-3

521

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

525

C. Effect

1. Accomplishment of daily tasks aboard ship
2. The necessity of the skills and techniques in repair of printed circuit boards.
3. Personal applications of the knowledge and skills  
Seek to motivate. Tell a good tie-in story if possible
- C. When following a subject matter lesson topic, do the following:
  1. Explain relationship of this lesson of previous lesson(s).

OUTLINE OF INSTRUCTION

D. Overview

1006

INSTRUCTOR ACTIVITY

2. Commend students for mastery of skills in previous lesson(s)

D. Overview lesson by:

1. Stating learning objectives as contained on cover pages to this topic

2. Stating procedures to be followed during the lesson

- a. Taking notes

3-4-5

STUDENT ACTIVITY

526

1007

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
	b. Asking questions	
	c. Use of criterion test	
	3. Invite questions concerning objectives and procedures	3. Ask questions concerning objectives or procedures if in doubt
<p>II. <u>PRESENTATION</u></p> <p>A. Types, sizes and usage of solderable connector pins</p> <p>1. Identifying solderable pins</p>	<p>A. Point out high points on slides while giving lecture on connector pins</p> <p>1. Display Slide YXH L11-S2,</p>	<p>A. Take notes - ask questions</p>

1008

1009

OUTLINE-OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

a. Although most pins can be soldered, only certain pins are DESIGNED to be soldered.

b. Identified by a curved cutout on one side of the pin.

c. Pins which have a small hole drilled in the side at the bottom of the wire socket can be identified as designed for crimping- the small hole is for visual inspection of wire bottoming prior to crimping.

2. Common types and sizes

a. Connector pin size- microscopically small - to so large that you would strain to lift it.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
b. The common sizes- those designed to accommodate wire between AWG 28 and AWG 14.		
c. Common, noncylindrical shapes of connector pins have the same shapes as terminals taught in previous lessons and will thus not be discussed in this lesson (eyelet, turret, and pierced tab, etc.)		
d. There are other less common and much more difficult to reliability solder pins in use which are taught in a more advance course.	d. Covered in NAVAIR micro course	
e. Concentrate on solder cup style connector pins		

529

1013



OUTLINE OF INSTRUCTION

3. Use

a. Connector pins serve as quick, easy disconnect points for disassembly of units

b. Connector pins serve to pass signals and voltages through airtight bulkheads

B. Preparing connector pins for soldering

1. Tinning - always tin the pin prior to soldering

INSTRUCTOR ACTIVITY

B. Display Slide YXH L11-S3

STUDENT ACTIVITY

530

OUTLINE OF INSTRUCTION

- a. Cleaning connector pins is difficult due to their shape; tinning is the preferred method.
- b. Connector styles which have remained unchanged for years are common, resulting in replacement connectors which have been stored for many years and which have the resultant oxidation on the surface.
- c. When repairing a connector for reuse (changing wires), old solder must be removed.
- d. The most reliable cleaning method for removing unwanted solder is to wick it out.

INSTRUCTOR ACTIVITY

a. Stress

c. Stress

STUDENT ACTIVITY

1016

1017

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

2. Prefilling

- a. Prefilling (form of tinning)-  
the placing of the correct amount  
of solder in the solder cup to  
form a finished solder joint.  
The used of preforms for consistent  
solder quantity is recommended.

- a. Display Slide YXH L11-S4

- b. Eliminating the need for a third  
hand to apply solder while holding  
the wire in one hand and the  
heating device in the other.

- b. Display Slide YXH L11-S5

- c. Preparing wire for soldering to connector  
pins

- c. Display Slide YXH-S6

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
1. Tools used - the same tools used in prior lessons	3. Stress - uniform tinning of wires	533
2. Stripping - same as previously taught.		
3. Tinning - tinning techniques are the same as previously taught		
4. Bending - no wire bending is required		
5. Cutting to length		
a. Cut wire to the proper length for soldering to connector pins		

1020

1021

3-4-12

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

b. Insert wire into connect cup to measure length of wire needed for that size of pin.

c. Ensure that the pin used as a depth guage is empty of solder

d. After the first wire is cut to proper length, it is used as a guage for cutting subsequent wires.

6. Insulating tubing

a. Insulating tubing should be used on all connector pins due to their close proximity and the danger of electrical short circuits

1022

0557-58P10

3-4-13

1023

534

535

OUTLINE OF INSTRUCTION

- b. Insulating tubing may be either fixed size or heat-shrinkable
- c. Heat shrinkable tubing is recommended as it provides good insulation with less bulk and is not subject to becoming useless from slipping up off the connection
- d. ALWAYS insert insulation over wire prior to soldering
- e. Tubing may be shrunk by using the solder extractor unit in the pressure mode for a heat source

INSTRUCTOR ACTIVITY

- d. Stress

STUDENT ACTIVITY

1024

1025

OUTLINE OF INSTRUCTION

- f. Exercise extreme caution when applying heat to shrinkable tubing (too much is worse than not enough)

D. Connector pin solder connection specifications

- I. Wire wrap - no wrapping to be done on connector solder cups
2. Wire position - the wire shall be aligned exactly with the axis of the connector pin
3. Wire depth - the wire MUST BE BOTTOMED IN THE SOLDER CUP to prevent flux or air being entrapped in the bottom of the solder cup

INSTRUCTOR ACTIVITY

- f. Stress

D. Display Slide YXH LII-S7

2. Display Slide YXH LII-S8

3. Stress: wire bottomed in cup

STUDENT ACTIVITY

536

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

4. Area to be soldered

4. Display Slide YXH.L1-S9

537

- a. Solder cup should be filled with a quantity of solder that will NOT allow the wire strands to be visible after soldering, but does not bulge beyond the confines of the cup or spill down over the sides of the pin.
- b. Edges of the cutaway portion of the cup shall be visible beneath the solder with no portion of the internal face of the solder cup showing.
- c. Circular, concave fillet around the wire where it enters the solder cup.

1028

1029



### OUTLINE OF INSTRUCTION

5. Solder quantity - shall be such that there shall be no solder spillage onto the outer walls of the pin, and the edges of the solder flow at all points shall meet the pin or wire in a concave fillet

#### E. Tools used to make connector pin solder connections

1. Hand tools

2. Power tools

a. Resistance soldering tweezers

### INSTRUCTOR ACTIVITY

1. Same as previously used

a. Stress safety precautions

### STUDENT ACTIVITY

538

OUTLINE OF INSTRUCTION

## F. Techniques for making high quality connector pin solder connections

1. Application of flux - except the flux contained in the solder, the application of flux is undesirable except in cases of extreme oxidation since excessive flux may become trapped in the bottom of the solder cup or cause solder spilling onto outside of the pin
2. Proper heat
  - a. In soldering connector pins there are three primary methods of applying heat, all of which are reliable

INSTRUCTOR ACTIVITY

## F. Display Slide YXH L11-S10

1. Stress no external flux needed

STUDENT ACTIVITY

539

1032

1033

OUTLINE OF INSTRUCTION

(1) Soldering iron used to solder a pin- using the conductive heating method. Note the use of the thermal shunt to prevent wicking

(2) A resistance probe used to solder a pin- using the resistive heating method

(3) Resistance tweezers used to solder a pin- using the resistive heating method

INSTRUCTOR ACTIVITY

(1) Display Slide YXH L11-S11.  
Stress thermal shunt and anti wicking tools

(2) Display Slide YXH L11-S12

(3) Display Slide YXH L11-S13

STUDENT ACTIVITY

0559-60 & 0526P10

3-4-19

1034

1035

540

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

540A

NOTE: Explain that there are two types of tips for resistance soldering, Carbon and Tungsten, each having its advantages: Carbon is easier to keep clean and provides greater heat, but is extremely fragile. Tungsten oxidizes and requires greater attention to keep clean, but is much more durable.

b. Conductive heating with the soldering iron is an acceptable method but has the following disadvantages

- (1) The tip must be extremely clean and dry to prevent leaving solder tins on the outside of the pin

1036

1037

### OUTLINE OF INSTRUCTION

- (2) The entire heating element of the iron must be hot for it to work, which may burn surrounding wire and insulation

c. Resistive heating with the probe (which heats by high current flow through the resistance of the pin itself) has the following disadvantages

- (1) It requires a second conductive lead which must be attached to some other part of the pin

- (2) Holding the single probe point against the rounded surface of the pin caused slippage which can result in severe arcing and burning of the pin

### INSTRUCTOR ACTIVITY

- (2) Stress- hot element and wire damage

### STUDENT ACTIVITY

3

0559-60&0526P10

3-4-21

1039

5408

1038

OUTLINE OF INSTRUCTION

d. Resistive heating with the resistive tweezers heats by the same method as the probe and has only the one disadvantage of arcing is misused.

e. Resistive soldering is extremely fast and efficient as a heating source and should be controlled by the following means.

(1) The current flow must be adjusted to the proper level for the thermal mass of the pin

(2) Great care must be used in adjusting the current level since most resistive heating sources are capable of pin DESTRUCTION by overheating if the current level is set too high.

INSTRUCTOR ACTIVITY

(2) Stress start at zero and turn up slowly for melt

STUDENT ACTIVITY

1041

OUTLINE OF INSTRUCTION

- (3) If using a stepped current source, fine control of generated heat is accomplished by utilizing a pumping action of the footswitch to apply power intermittently

3. Application of solder

- a. In connector pin soldering, the wire is applied to the wire solder rather than applying the solder to the wire as you have been doing.
- b. To properly apply the wire to the solder, use the following steps:

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

- (1) First step should be to place an antiwicking tool on the wire. The wire insulation should always be firmly bottomed in the larger section of the hole drilled through the tweezer tool head, and the jaws thoroughly cleaned of any flux or other foreign matter

- (2) If using the resistance heating method, thoroughly clean the tool tip with emery cloth prior to placing on the terminal as oxide buildup may cause arcing.

- (3) Always place the tool tip on the pin prior to applying power to prevent arcing and burning of the pin.

### INSTRUCTOR ACTIVITY

- (1) Display Slide YXH L11-S14. Stress antiwicking tool use

### STUDENT ACTIVITY

543

1045



ED193528

Information Series No. 208

COMPETENCY-BASED ADULT EDUCATION:  
A CHALLENGE OF THE 80s

written by

Carol Kasworm  
University of Texas at Austin

The ERIC Clearinghouse on Adult, Career, and Vocational Education  
The National Center for Research in Vocational Education  
The Ohio State University  
1960 Kenny Rd.  
Columbus, Ohio 43210

1980

U.S. DEPARTMENT OF HEALTH  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

CE 027 091

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- (4) Apply power (or the soldering iron) and observe the pin for solder melt.
- (5) Upon solder melt, immediately insert the tip of the wire partially into the solder cup at about a 70-degree angle and hesitate for a second to allow heat sinking action of the cold wire to be overcome.
- (6) After the solder remelts, VERY QUICKLY move the wire to a full vertical position and bottom it in the solder cup.

## FUNDING INFORMATION

Project Title: ERIC Clearinghouse on Adult, Career, and Vocational Education

Contract Number: NIE-C-400-76-0122

Educational Act  
Under Which the  
Funds were  
Administered: 41 USC 252 (15)  
and PL 92-318

Source of  
Contract: U.S. Department of Education  
National Institute of Education  
Washington, D.C.

Contractor: The National Center for Research in Vocational Education  
The Ohio State University  
Columbus, Ohio

Executive  
Director: Robert E. Taylor

Project Director: Juliet V. Miller

Disclaimer: This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Education. Contractors undertaking such projects under government sponsorship are encouraged to freely express their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official National Institute of Education position or policy.

Discrimination  
Prohibited: Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance."  
Title IX of the Education Amendments of 1972 states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefit of, or be subjected to discrimination under any education program or activity receiving federal assistance." The ERIC Clearinghouse project, like every program or activity receiving financial assistance from the U.S. Department of Education, must comply with these laws.



This Publication was prepared with funding from the National Institute of Education, U.S. Department of Education, under Contract No. NIE C-400-76 0122. The opinions expressed in this report do not necessarily reflect the position or policies of NIE or U.S. Department of Education

OUTLINE OF INSTRUCTION

- (7) Maintain a slight downward pressure on the wire until the power (soldering iron) has been removed and the solder has solidified. This downward pressure will aid in preventing the formation of stress lines in the solder.

G. Cleaning after soldering .

- a. As ALWAYS, the soldered connection must be properly cleaned after completion.
- b. The most effective method for connector pins is the use of a bristle brush and solvent.

INSTRUCTOR ACTIVITY

G. Display Slide YXH-S15.

- a. Stress cleaning

STUDENT ACTIVITY

545

10-19

10-18

## ABSTRACT

This paper is a descriptive presentation of the state-of-the-art of competency-based adult education (CBAE). Readers are provided first with a brief history of the development of the concept and are presented with basic terminology. Then, because CBAE is multi-dimensional, varied notions of functional adult education are discussed and major strands of diversified program and instructional processes are described. In addition, administrative perspectives and current research issues are presented. The paper provides background for understanding the current status and direction of several CBAE programs. It reflects the current base of limited written resources and the supplementing of discussions with personal communication. It presents an overview of the nature of CBAE, the foundations of a CBAE process, the scope of CBAE systems, teaching/learning strategies, administrative trends and issues, and the current state of research in this area. Tables illustrate (1) APL model of functional competency, examples of tasks, and (2) five-state comparison of adult alternative programs. Appended materials include a list of potential resources concerning programs, bibliographies and product listings, and suggested readings. (CT)

DESC:: Nontraditional Education; \*Adult Education; \*Competency Based Education; \*Educational Research; Learning Activities, Adult Basic Education; High School Equivalency Programs; \*Educational Resources; Models; \*Program Administration; \*Program Design; Program Development; Teaching Methods; State of the Art Reviews

IDEN:: Information Analysis

OUTLINE OF INSTRUCTION

H. Inspecting completed connector pin solder connections for quality

1. Standards of acceptance

a. Correct insulation clearance

b. Correct insulation clearance

c. Proper solder quantity

● SMOOTH gleaming solder finish

INSTRUCTOR ACTIVITY

H. Display Slide VXH L11-S16

STUDENT ACTIVITY

8750-51P10

3-4-27

546

2051

ADMINISTRATIVE TRENDS AND ISSUES IN COMPETENCY-BASED ADULT EDUCATION	28
STATE ACTIVITY IN CBAE	28
STAFF DEVELOPMENT FOCUS	29
COSTS VERSUS BENEFITS OF CBAE	30
CURRENT STATE OF RESEARCH IN COMPETENCY-BASED ADULT EDUCATION	33
WHAT IS COMPETENCY?	33
MEASUREMENT OF COMPETENCY	34
IMPACT OF CBAE	35
SUMMARY	36
APPENDIX	38
REFERENCES	45

OUTLINE OF INSTRUCTION

2. Indications to look for

a. Preferred solder connections

(1) Concave solder fillets

(2) Bright, gleaming finish

(3) Ideal amount of solder

(4) No solder spillage

INSTRUCTOR ACTIVITY

a. Display Slide YXH L11-S17

STUDENT ACTIVITY

547

1053



## PREFACE

Competency-Based Adult Education (CBAE) is becoming recognized as a viable process and approach for adult literacy programs. However, because of recent developments in this field and its diverse, segmented activities, many practitioners and lay persons are unaware of its potential program impact. Many persons lack information concerning elements of a competency-based education strategy, in general, as well as the specific program structures of CBAE activities. This paper is designed to address these informational needs.

Competency-based Adult Education: A Challenge of the 80s is a descriptive presentation of the state-of-the-art of competency-based adult education. Readers are provided first with a brief history of the development of the concept and are presented with basic terminology. Then, because competency-based adult education is multi-dimensional, varied notions of functional competency are discussed and major strands of diversified program and instructional processes are described. In addition, administrative perspectives and current research issues are presented.

The paper provides background for understanding the current status and direction of several competency-based adult education programs. However, as with any state-of-the-art discussion, certain limitations should be noted. Some limitations result from an attempt to present a balanced overview of current practices which are in process of pilot-testing, of refinement, and, often, major revision. Program and instructional developments are not static; they have been temporarily "captured at one point in time" for descriptive understanding. Consequently, some program information may not be comprehensive enough for

OUTLINE OF INSTRUCTION

(5) Insulation clearance is correct

- b. No solder defects, especially stress lines, which are common in solder cup connections

3. Reasons for rejection

- a. Unacceptable solder cup connection for the following reasons

- (1) There is a large stress line at the bottom of the solder cutout

INSTRUCTOR ACTIVITY

- a. Display slide YXH L11-S18

- (1) Stress the stress line on slide

STUDENT ACTIVITY

## INTRODUCTION

"That one man should die ignorant who had the capacity to learn, this I call a tragedy." Thomas Carlyle.

"Why do we always get the thorny stem, rather than the flower of the rose?" Student comment in an adult basic education class.

Adult literacy education has espoused the mission of serving the disadvantaged. However, often the vision and the reality of its efforts resided in far separate worlds. During the years of the 1970s, adult literacy education incorporated stronger funding, new outreach efforts, innovative and (hopefully) more effective delivery systems and instructional strategies.

One key development during these years was the competency-based approach to adult education. This new perspective appeared to offer better solutions for educational and programmatic outreach in adult basic education. In the early 1970s, two separate, yet interactive developments focused national interest on and practitioner support for competency-based approaches to adult basic education. Attention was focused on the needs for a concept of literacy appropriate to adults and a more flexible, accessible, and relevant process to service diverse adult illiterate learners.

The first development addressed a concept of literacy in relation to the life orientation of the adult. During the 1900s, American society had undergone significant shifting of resources and expectations towards defining the high school diploma as the "benchmark of education literacy" (Hunter & Harmon, 1979). This rising set of expectations was most dramatically

OUTLINE OF INSTRUCTION

(2) The wire is birdcages below the insulation

(3) The wire is nicked

B. Other defects to look for

(1) Improper insulation clearance

(2) Solder spilled on sides of terminal

(3) Arc spots on sides of pin caused by improper use of the resistance soldering tools

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

549  
bhs

1057

Non-traditional education - education that rejects lockstep curricula, traditional graduated subject-level learning, and campus-bound classroom activity - had gained significant support. Until the 1970s, undereducated adults had only three major alternatives for gaining a secondary education - a traditional evening high school program, a correspondence course of study, or a high school equivalency instruction/testing program. These options were insufficient for many adults who found these programs either irrelevant to their situation or inaccessible to them. Some who went through these programs found that a high school equivalency diploma was not always an acceptable substitute for the traditional high school diploma.

In 1973, the Policy Institute of the Syracuse Research Corporation presented the Ford Foundation with a proposal for an alternative to a high school diploma. With strong educator leadership and direct input from representatives of adult basic education, labor, business, and the community, a developmental effort was undertaken to establish content areas of adult competency and guidelines for granting an external high school diploma. A New York State grant with federal backing was provided to develop the idea further and to establish a working model for an external high school diploma program (Nickse, 1979). The Regional Learning Service inaugurated the New York External High School diploma program oriented solely to adults. This program had no operational instructional classroom component. The core of this external approach was a defined set of competencies, assessment measures, and resource counseling and advisement center. This was followed in 1974 by the establishment of the experimental Monmouth Adult Education Commission Adult Diploma Program instituted by the New Jersey Department of Education (Niles, 1980). These nontraditional high school diploma programs offered new flexibility and relevance to adults. Utilizing competency-based processes, they provided a new, accessible approach for adults who desired both the knowledge and the credential.

Since these early major efforts, numerous local, state, and federal agencies and educational groups have joined in the creation and refinement of competency-based adult education. This paper provides an overview of the elements of this innovation. The current state of CBAE programs and processes, research and administrative issues, and key perspectives on functional competency and learning strategies are presented. It is hoped this paper will provide understanding and insights into the current scope and impact of competency-based adult education.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>I. Safety precautions</p> <ol style="list-style-type: none"> <li>1. Even though the resistance tools are operated at a very low voltage, there is always a chance of shock if the hands are wet. Use common electrical safety precautions to prevent injury</li> <li>2. Same safety as previous lessons</li> </ol>	<p>I. Display Slide YXH L11-S19</p>	
<p>J. Demonstration</p> <ol style="list-style-type: none"> <li>1. Soldering connector pins</li> </ol>	<ol style="list-style-type: none"> <li>1. Instructor should demonstrate the proper techniques and use of tools while showing the students how to solder connector pins as presented during the lesson</li> </ol>	<ol style="list-style-type: none"> <li>1. Observe and ask questions if necessary</li> </ol>

activities. Postassessment determines the student's present level of skills and knowledge of the stated competencies of the program and certifies the student's final competence in the skills addressed by the program.

#### Functional Literacy

CBAE structures are generally grounded in functional literacy subject matter, "basic and life skills necessary for the individual to function proficiently in society." This integration of both basic and life skills is a key component of successful CBAE efforts.

There are many variations in the specific mixture and content of basic and life coping skills and knowledge. All CBAE programs stress the development of basic skills (reading, computation, writing, problem-solving, listening/viewing/speaking). Certain programs also incorporate competencies in interpersonal relations, cross-cultural relations (predominantly in English as a Second Language programs), and humanistic concerns.

Life skills competencies tend to focus on life roles such as employee, consumer, citizen, family member, healthy individual, and/or personal problem-solver. The nature of these competencies varies based upon the structure and results of the original, foundational research for the program, upon variations in regional location (cultural, ethnic, rural/urban differences), upon clientele service orientation (e.g., state welfare clients, rehabilitation clients, or non-English-speaking participants), and upon the perceived goal certification for the learner (high school diploma, GED preparation, vocational).

The functional literacy approach assumes that basic skills are learned through a focus in life-coping skills. For example, the Adult Performance Level (APL) Project has defined functional competency as a two-dimensional concept of an identified set of basic skills as they apply to five general knowledge or content areas. Table 1 outlines this concept and provides examples of the interaction of basic skills and knowledge within a functional literacy, life-coping orientation.

#### Certification of Mastery

Ideally, CBAE processes/programs should provide certification of mastery of competencies. Many CBAE programs have linked their efforts to an external or nontraditional high school diploma program. Thus, successful completion or mastery of the competencies certifies an adult for a high school diploma. Certain programs link mastery of their competencies to entry into other programs such as vocational training, conventional

OUTLINE OF INSTRUCTION

III. APPLICATION

A. Performance Sheet 3-4-1

IV. SUMMARY

A. Introduction

1. Nature of summary

2. Purpose of summary

B. Directions to students

INSTRUCTOR ACTIVITY

A. Supervise each student's completion of performance sheet 3-4-1

A. Emphasize importance of the summary for the student

STUDENT ACTIVITY

A. Complete performance sheet 3-4-I. Ask questions if procedures are not clear

151

1001



high school diploma, or GED instructional preparation. Other programs offer a certificate of accomplishment for attainment of the designated skills and knowledge.

#### PROGRAM ORIENTATIONS OF CBAE

##### Variable Instructional Structures or Processes

Most CBAE programs do not prescribe one instructional process or method for their students. When knowledge, skills, and attitudes outcomes are prescribed and assessed through competencies, students may elect learning strategies from a wide array of differing approaches with the advice and help of teachers or assessors/counselors. Programs may utilize instructional modules, group presentations and discussions, self-directed learning, student-initiated performance activities, teacher-with-student or student-with student teaching, tutoring, and other uniquely suited learning strategies which best assist the student to gain competence. Certain CBAE programs have an established competence-oriented curriculum with individualized instructional materials (e.g., APL system). Certain systems provide educational brokering services to direct students to other community resources and courses for information and/or instruction (e.g., New York External High School Diploma Program). Certain programs offer a learning resource center approach which provides a variety of materials and media identified to provide instructional support for basic skills development (e.g., New Jersey MAECOM Adult Diploma Program). Lastly, a few programs offer small group and individualized instruction where students interact on a regular basis with teacher-student groupings.

The CBAE use of various instructional processes represents philosophical differences regarding program structure, adult learning styles, available community learning resources, and the outcomes of the program. The CBAE process strives to make maximum use of alternative learning and instructional processes in order to bring about attainment of competencies in the most effective manner. Although the specific competencies are prescribed, there is not a dominant instructional process, nor one specific instructional strategy for all students.

##### Adult Learner Orientation

Because of the focus on the disadvantaged adult learner, CBAE programs have attempted to integrate key concepts of effective and efficient learning in relation to the adult. For example, adults have significant work and family time commitments which may make it impossible for them to maintain

<u>OUTLINE OF INSTRUCTION.</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
1. Questions		
2. Notes		
C. Recap of lesson	C. Emphasize safety	C. Ask questions if material not clear; check notes to insure accuracy and completeness
1. Demonstration will cover lesson recap	✓	

1062

552

structure to a CBAD approach. These programs typically have two or three of the above stated elements. Lastly, some programs focus upon outcome objectives or functional literacy skills, yet they do not support or emulate the philosophy of CBAD. As with any innovation, there are many levels and varieties of application of the concepts and structure of CBAD to local adult education programs.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
V. <u>INFORMAL TEST</u>		
A. There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application".		
VI. <u>ASSIGNMENT</u>		
A. Assignment Sheet 3-4-1A	A. Provide students with the homework assignment	A. Ask questions if the assignment is unclear. Complete assignment.

553

1064

1065

five knowledge areas - consumer economics, occupational knowledge, health, community resources, and government and law (See Table 1). These forty-two competencies are utilized through the adult basic, pre-GED, and the APL diploma program (Shelton, 1979).

The New York State External High School Diploma Program is called an applied performance assessment system specifically developed to provide a non-traditional process for earning a high school diploma. The program regards competency as specific skills or knowledge through which a candidate can demonstrate performance mastery. The program has identified sixty-four basic skills and generalized competencies in communication, computation, social awareness, consumer awareness, scientific awareness, and occupational preparedness as well as specialized competencies in individualized occupational or vocational skills, advanced academic skills, and specified skills in areas such as art, music, and community organization. The generalized competencies are combined with specialized competencies to compose the total system of the diploma program.

The sixty-four basic competencies in this diploma program were initially defined by a task force of fourteen criteria-selected individuals. These were reviewed and refined by representatives of various community, business, education, and social groups. In its capacity as school board for the program, a regional committee of selected community leaders reviewed and critiqued the competencies for final approval (Nickse & McClure, in press). These competencies continue to be refined in their performance mastery application by educators working with disadvantaged adults in the diploma program.

California conducted a statewide analysis to identify necessary competencies for functional economic and educational success in today's society. Specific competencies were evolved from a literature review; a listing of generalized competencies; the composition of an organization framework; specific statements generated by an expert panel; and extensive review, rewriting, and editing (NOMOS, May, 1978). These five main categories include competencies in cultural, economic, health and safety, interpersonal, and social-political areas. Each category was further divided into subcategories with specific competency statements for each subcategory. The research incorporated work done through a pilot-tested competency-based diploma program in the Los Angeles Unified School District. This program defined thirty competencies, judged by adult students, adult education teachers and administrators, and community representatives to be most vital to a functional competency curriculum (McCune, 1979).

The California State Department of Education views the relationship of functional competency to adult education as a dynamic process

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Minature/Microminiature Electronic Repair  
(2M) Program A100-0034

Lesson Topic 4.1:  
Introductions to Micro-Electronic Circuit Boards

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 1.0 Hours  
Laboratory - 0.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

a. MERP/ZM Kit

2. Training Aids

a. Slides

(1) YXP-L2-S1 through YXP-L2-S5

3. Training Aids Equipment

a. Projector, slide

b. Screen, Projection, Standard

4. Text

a. Student's Guide

5. References

a. MIL-STD-454D

TERMINAL OBJECTIVES

Supported entirely by this lesson topic: NONE

Supported partially by this lesson topic:

6.0 REPLACE component parts on micro-electronic printed circuit boards using the correct tools and soldering techniques and APPLY the proper conformal coating in accordance with the procedures and to the standard outlined in MIL-STD-454D.

7.0 REMOVE conformal coatings from micro-electronic printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.

8.0 REMOVE micro-electronic printed circuit board component parts using the correct tools and desoldering techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.

ENABLING OBJECTIVE

When you complete this lesson topic, you will be able to:

efforts to define and develop a set of life role competencies that all students should attain by the conclusion of their high school years, identified the major four areas of (1) employability and occupational skills, (2) personal and family management, (3) civic and social responsibilities, and (4) aesthetic and humanistic appreciation (Michigan Life Role Competencies, 1977).

In addition to these applications of functional competencies, thirty-three states have taken some form of action to mandate minimum competency standards for elementary and secondary students. All of the remaining states either have legislation pending or legislative or state board studies examining minimal competency requirements (Pipho, 1978). Because of this major activity, many state adult education programs are being challenged to conform to (and develop) minimum competency standard requirements for high school graduation. Of equal importance, competency-based adult education programs are drawing in secondary educators and school districts who desire to investigate the feasibility of incorporating competency-based adult education concepts into traditional curriculum systems.

#### LIMITATIONS OF FUNCTIONAL COMPETENCY DEFINITIONS

All of these comprehensive or specific efforts toward defining functional competency have their weaknesses. As noted by Fischer, "a specific competency is rarely applicable to all people. Geographic location, sex, age, ethnic background, life stage, and other factors affect both the individual and social perception of necessity" (Fischer 1979, p. 148).

As the most publicly visible and the only national research-based study, the APL study has generated considerable controversy and thus heightened educator and researcher concerns for validation of functional competencies for specific regional or clientele groups. Although most educators endorse the generic concept of APL functional competency, several critics have questioned the specific composition of objectives in the APL study, its application to disadvantaged adults, and its middle-class value bias (Griffith and Cervero, 1977; Fischer, 1979; Cervero, 1980; Nyer, 1979). For example, in research analyzing self-perceived needs of New Jersey adult basic education (ABE) students, Flaherty noted that students, on the average, wanted to learn about 59.6 percent of the APL competencies. Students with the lowest reading levels expressed more interest in competencies that involved basic reading skills. Occupational knowledge and consumer economics knowledge areas were identified by students as having highest priority, whereas health and community resources knowledge areas generally held lesser interest for students (Flaherty 1978). Other functional competency models also suffer

- 4.1.1 IDENTIFY the characteristics and handling of micro-electronic circuit boards. Identification will be complete agreement with the characteristics outlined in MIL-STD-454D.

#### CRITERION TEST

The students will be required to identify selected micro-electronic boards by their various physical characteristics and practice the proper handling of the same boards in accordance with the information outlined in MIL-STD-452D.

#### HOMEWORK



## THE SCOPE OF COMPETENCY-BASED EDUCATION SYSTEMS

Competency-based adult education has been incorporated into adult education programs throughout the United States. The Department of Education's Division of Adult Education indicated that in 1977-78 forty-three states were sponsoring 153 separate CBAE-related special programs during the fiscal year with a total investment of approximately \$8 million (Profile of the States, 1978). During fiscal year 1979, Clearinghouse for Adult Education and Lifelong Learning (ADELL) identified special adult functional competency projects in forty-seven states with a total funding of approximately \$7 million (Fiscal Year 1979 Fundings for Adult Functional Competency Projects, 1980). The latter does not identify three traditionally-funded programs that also have incorporated CBAE into their outreach efforts but are not now receiving special funding. For example, they do not represent the twelve APL pilot high school diploma program sites in Texas or the Oregon CBAE Community College High School Diploma Program.

Competency-based education encompasses a wide range of activities and programs. The scope of these efforts can be categorized by the functional characteristics of the CBAE program in relation to current adult basic education activities. In examining CBAE programs, the three major systems include (1) credential-oriented systems, which have external and nontraditional high school diploma programs; (2) linkage systems which may incorporate Adult Basic Education, English as a Second Language, prevocational and/or vocational education, pre-GED and/or GED programs, or job readiness programs, and (3) adaptations systems, which focus the functional literacy CBAE approaches to service special populations.

OUTLINE OF INSTRUCTION

I. INTRODUCTION

A. Contact

B. Readiness

INSTRUCTOR ACTIVITY

A. Introduce self and topic.  
Provide for students needs:

1. Muster

2. Comfort

3. Visibility and seating

B. Explain value of subject  
matter, pointing out where  
appropriate, its relation-  
ship to the following:

STUDENT ACTIVITY

structure of functional competencies, individualized and varied instructional experiences in developed sets of learning resource materials, and a pre/post assessment system. As with the focused assessment model, there is no linkage to Carnegie-unit certification.

The model is exemplified by the Texas APL Competency Based Diploma Program. This program awards the high school credential for demonstration of a satisfactory score on each objective of American College Testing Program's APL Content Area Measures, successful demonstration of a series of life skills activities, and demonstration of (1) marketable job skills, (2) college or vocational school readiness, or (3) demonstration of skills in home management/maintenance. Within Texas, this program has awarded over 1,000 diplomas and currently has approximately 1,300 candidates (Shelton, 1979).

In addition to the APL high school diploma program, California is currently designing and implementing the California Competency Based Adult Diploma Program (CALCOMAP). This project is creating competency achievement packets (CAPs), which will assess and teach functional competencies in a total assessment and curriculum model. Currently pilot tested in the Los Angeles Unified School District, this diploma model will be incorporated into other adult education programs in California (Tibbetts and Westby-Gibson, 1979).

#### Combined Model of Assessment, Alternative Learning Resources, and Carnegie Unit Certification

High school diploma programs in this model are "hybrids," drawing upon both traditional secondary education certification and upon present learning resources in adult education programs, while also incorporating innovative structures of functional competencies, assessment systems, and alternative learning instructional modes. Several of the state and local district programs in this model group have incorporated credit for prior life and educational experiences in relation to program-defined functional competencies. All of the programs in this model have translated the mastery of functional competencies into academic credit or Carnegie units.

There are three major programs which, at present, characterize this model - the Oregon Adult Diploma Program, the Massachusetts New Bedford Adult Diploma Program, and the MAECOM Adult Diploma Program in New Jersey. Each of these three programs that was cited above has incorporated the CBAE process in unique ways while at the same time conforming to local educational environments. Each program varies dramatically in its forms of instruction (from formal required classes to mentor-facilitated

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

557

1. Accomplishment of daily tasks aboard ship.
2. The necessity of the skills and techniques in repair of printed circuit boards.
3. Personal applications of the knowledge and skills.
4. Seek to motivate. Tell a good tie-in story if possible.

1072

TABLE 2  
FIVE-STATE COMPARISON OF ADULT ALTERNATIVE PROGRAMS

PROGRAM	CERTIFICATION REQUIREMENTS	TYPE - INSTRUCTION	TYPE - ASSESSMENT	DOCUMENTED TYPE- PRIOR LEARNING
<u>MASSACHUSETTS</u> New Bedford Adult Diploma	<ol style="list-style-type: none"> <li>1. 16 Carnegie units including U.S. History (7 required, 9 elective)</li> <li>2. High School level reading achievement 4 cr.</li> <li>3. Math achievement - 2 cr.</li> <li>4. Writing and grammar achievement</li> <li>5. one term enrollment (+ - 12 weeks)</li> </ol>	<p>classes special tutoring independent learning self-paced</p>	<p>standardized tests; documentation of life skills in 11 areas; employ- ment, training program, home management, travel/ sports/rec; family, health ed; fine arts, practical arts; volunteering; language; military; ind. project</p>	<p>life skills options in 11 areas (9 credits total)</p>
<u>NEW JERSEY</u> MAECOM Adult Diploma Program	<ol style="list-style-type: none"> <li>1. 80 credits, inc. U.S. History</li> <li>2. 10.5 grade level in reading, math, and English</li> </ol>	<p>formal classes self-instruction on job training mentor-learner instruction independent self- paced instruction</p>	<p>product and perfor- mance assessment; oral and written exams</p>	<p>work exp. 10 cr; military, 10 cr; apprentice + 30 cr; special skills 5 cr, formal course work 1+ cr.</p>
<u>OKLAHOMA</u> Adult Diploma Program	<ol style="list-style-type: none"> <li>1. 21 Carnegie credit re- quirements (11 required, 10 electives)</li> <li>2. Competence in 10 life skills areas</li> <li>3. Attendance one semester full-time or two semesters part-time</li> </ol>	<p>college classes in high school subjects voc. ed independent learning</p>	<p>all types of standardized tests; projects; independent learning</p>	<p>life exper- iences (special skills); work experience (inc. Military); course work; correspondence, technical, etc.)</p>

OUTLINE OF INSTRUCTION

C. Effect

D. Overview

INSTRUCTOR ACTIVITY

C. When following a subject matter lesson topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).
2. Commend students for mastery of skills in previous lesson(s).

D. Overview lesson by:

STUDENT ACTIVITY

558

TABLE 2  
FIVE-STATE COMPARISON OF ADULT ALTERNATIVE PROGRAMS, Con't.

PROGRAM	CERTIFICATION REQUIREMENTS	TYPE - INSTRUCTION	TYPE - ASSESSMENT	DOCUMENTED TYPE- PRIOR LEARNING
<u>NEW YORK</u> <u>STATE</u>				
External High School Diploma Program	<ol style="list-style-type: none"> <li>64 basic skills in communication, computation and life skills awareness: in self; social; consumer; scientific; and occupational preparedness plus</li> <li>Occupational skills; or college readiness; or special skills</li> </ol>	<p>NO INSTRUCTION: learners use community resources and family independent learning. w/learning pre-descriptions self-paced instruction</p>	<p>Take-home exams; diagnostic exams; self-assessment; oral interviews; applied performance tests</p>	<p>special skills; occupational skills</p>
<u>TEXAS</u>				
APL High School Diploma Program	<ol style="list-style-type: none"> <li>pass adult performance level test (APL)</li> <li>Demonstrate life skills</li> <li>Occupational or post-secondary school readiness; or home mgt/maintenance</li> </ol>	<p>All types instruction: (class independent); APL curricula used All individual and self-paced</p>	<p>APL test; product assessments; occ/voc</p>	<p>occupational skills including military</p>

Source: Nickse, 1980. (with modifications)

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
	1. Stating learning objectives as contained on cover pages to this topic.	559
	2. Stating procedures to be followed during the lesson.	
	a. Taking notes:	
	b. Asking questions.	

1076



## LINKAGE CBAE SYSTEMS

In addition to the major emphasis of recent CBAE activities in alternative high school diploma programs, many CBAE concepts and processes are also being incorporated into other adult education program efforts. Linkage CBAE systems are programs of Adult Basic Education, English as a Second Language, prevocational/vocational education, and pre-GED/GED programs that integrate traditional subject matter within a CBAE process and framework. Many of these programs were initially attracted to CBAE because of the potential infusion of functional literacy concepts. In a comparative six city research project of adult basic education, it was observed that teachers had seldom incorporated life skills into their instruction (Mezirow, Darkenwald, and Knox, 1975). In a focused research investigation of adult basic education instructional practice, it was noted that those teachers who do emphasize life skills with disadvantaged adults have lower dropout rates among their students (Darkenwald, 1975). In a Louisiana research study of comparative groupings of traditional and APL instruction in adult basic education, students in the APL instruction groupings not only had greater test score changes in life coping skills, but also demonstrated a higher overall retention rate (Nauzat, 1978a, 1978b; Report of the USOE Invitational Workshop on Adult Competency Education, 1978. This infusion of life skills into adult education classrooms appears to offer a more relevant and attractive learning experience with possible positive impact on student retention rates.

Adult basic education programs, those programs that traditionally have provided instruction to the illiterate adult up through the eighth grade level of skills and knowledge, have found significant value in CBAE. These programs often are not total systems with the ability to provide a form of certification at the point of mastery of competencies, but rather linkage on feeder systems that (ideally) provide sufficient instruction to bring the adult's knowledge and skill to the level of entry into a vocational, GED preparation, or high school diploma program. These programs, focused on basic skills development, utilize functional life-coping skills as a point of orientation and a set of designated competencies as a framework of instruction (Royce, 1979). ABE-CBAE programs are extremely variable in scope as can be demonstrated by the Lancaster-Lebanon, Pennsylvania Program which welded together a competency-based adult education program using elements of CLTP (the Community Action Program (CAP) Employment-Training Program), the Adult Learning Resource Center model as practiced in a variety of states, and the modified ABE program with life skills instruction as taught in Louisiana and Worcester, Massachusetts.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

c. Use of criterion test.

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives or procedures if in doubt.

II. PRESENTATION

A. Definition and Scope of Micro-Miniature Electronic Repair.

A. Display Slide YXP-L2-53

A. Students take notes, ask questions.

1. Definition - Micro-Electronic Repair, as it pertains to this lesson, is any electronic repair which requires a performance skill level greater than possessed by the "Average" repair technicians.

retaining jobs (Reive et al., 1978).

Adult educators are initiating, designing, and implementing CBAE programs, curriculum, and instructional components for other greatly underserved groups, such as the mentally retarded, occupationally or physically disabled, the learning disabled, the elderly, and the homebound or institution-bound adult. In addition, adaptations of curriculum and research into "culture-bound" functional competencies are also being considered for groups of Eskimos, Native Americans, and inner-city youth. These activities are in the beginning stages of growth and hopefully, in future years, will offer exciting additional components to the CBAE scene.

The scope of current CBAE activity is quite diversified. Its application ranges from total high school diploma programs, to linkage efforts with current educational systems serving disadvantaged adults, to special adaptation systems of pilot projects oriented toward special-need populations. Although there are a few major innovative programs that have created a new CBAE system in adult education, the majority of activity in the field is focused on adapting or linking the concepts and processes of CBAE within current program efforts.

OUTLINE OF INSTRUCTION

2. Abilities and skills to be achieved during course.

a. Proper identification and use of all components of the 2M Micro-Miniature Electronic repair Stations.

b. Correct analyzation of workpiece construction and evaluation of damage to be repaired.

c. Identification of high quality micro-miniature solder connection characteristics.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

561

30

(Mann, 1979). CBAE programs that have drawn their focus from a non-APL research base regarding functional competencies have typically developed their own written functional literacy assessment instrumentation.

Beyond these written forms of assessment, a few programs (e.g., New York and New Jersey diploma programs) also have integrated life skill performance indicators. Philosophically, CBAE programs generally support the concept of relevant life skills in combination with an "action orientation." Performance outcomes are believed to be more credible and valid by the act of doing. If it were economical and feasible, several CBAE programs would prefer final competency to be demonstrated by real-life or simulated application performance. For example, in the New York State External High School Diploma Program, proficiency in the stated competencies is assessed through five major task assignments that require application and integration of skills to adult-related activities, such as selecting an appropriate apartment (Nickse & McClure, in press).

#### CURRICULUM MATERIALS DEVELOPMENT

The implementation of a CBAE system requires a reexamination of current teaching-learning resources and, depending on the program, the development and/or adaptation of materials and teaching aids. Many CBAE programs, in collaboration with publishers, have created new materials that provide both basic skills development and a life skills orientation within the framework of lesson units. These materials are becoming sufficiently diversified to provide programs with alternative selection of materials. For example, these materials include: Cambridge's Reading for Survival series, PAR's Label packets, Pitman Learning's Ablest Readers and Lifeline series, Harcourt Brace Jovanovich's The APL Series, McGraw-Hill's Lifeworks, and soon to be published by Pitman Learning, the Competency-Based Life Ability Skills (CLASS) project modules produced from the CALCOMP project in California. In addition to these new written materials, several programs have developed audiovisual resources. Key examples include a videotape series entitled "Just Around the Corner," developed by the Mississippi Authority for Educational Television in cooperation with Cambridge Book Company; the Life Skills Stimulus Video Tapes and Teacher's Guide from the New England Regional Life Skills Advisory Board; slide-tape and cassette tape productions from the APL curriculum; and numerous other filmstrips, slides, and transparencies developed from many 309/310 curriculum/materials development projects. Both the written and audiovisual resources offer CBAE programs functional literacy materials oriented to the development of both basic and life coping skills.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- d. Proper utilization of tools and techniques to remove conformal coatings, perform desoldering, and remove components from the work piece.
  - e. Proper utilization of tools and techniques to install micro-electronics components on single and double sided printed circuit boards.
  - f. Correct preparation, application and curing of conformal coatings.
- B. Characteristics of micro-miniature solder connections on single and double sided boards.

the areas of reading, writing, language, and mathematics. These skill diagnostic statements describe either the student's current level of need for further basic skill development or the mastery of basic skills. In addition, the file also provides a composite breakdown of the present assessed level of each functional competency and component objectives of the student. In APL-related programs, the file may also include a student interest form, which notes the priority of student interest in each of the functional competencies. For example, a student may have noted a desire to learn first about counting money or how to do comparison shopping. Information on (1) basic skills levels, (2) functional competency skills levels, and (3) student interest provides the key information for development of an individual program of study. The file is set up to note the entry level and the on-going progress of the student in both basic skills and functional competency areas. Certain CBAE programs also provide a progress chart or life skills portfolio for student use. This chart or file notes the total number of completed functional competencies or individual documentation of accomplished life skills. Students check off or incorporate proof of completion as they progress in fulfilling each competency or post-assessment measure.

A few alternative high school diploma programs have also established a documentation system of credit for prior life experiences or credit for life experiential learning, the former oriented to activities prior to entry into the program and the latter to activities demonstrating current knowledge and competence. Programs that give credit for life experiences utilize trained diploma assessors as well as community professionals who evaluate the student's experiential learning in relation to the number of credits to be awarded for educational activity. This assessment occurs at key points in the student's program. Although record keeping is predominantly an instructional management concern, documentation of competency in relation to academic or Carnegie unit credit is a significant instructional decision-making process. At the present time, both traditional educators and CBAE instructional staff are raising serious questions regarding the validity and credibility of relating concepts of functional competency to academic or Carnegie units of educational credit.

These four designated areas - assessment, curriculum development, alternative learning systems, and record keeping/documentation - represent areas currently experiencing the most significant scrutiny and adaptation for the CBAE process. A few of these areas may appear to be peripheral to the core instructional process. However, the very nature of the CBAE instructional process involves diversity oriented to the needs of students and features a more flexible entry/exit system. Control is provided through appropriate assessment processes and documentation/record keeping systems.

088

088

563

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Solder connection characteristics.

1. Slide of characteristics.

a. Solder area

a. Point out on slide and pass board around.

b. Solder quantity

b. Use slide, pass board around.

(1) Preferred

(2) Acceptable

(3) Lead contour visible

1089

1089



educational needs (California Adult Competency Survey); competency-based adult diploma program (CALCOMP) and related materials (CAPS); an information, collection, dissemination, and evaluation service (ICDES) in curriculum materials; and a process model of staff development (California Adult Competency Education Project). Texas has supported APL curriculum development, CBHSD (Competency Based High School Diploma Program) pilot site activities, and staff development projects in CBAE and CETA/CBAE linkages. In addition, New Jersey is presently in the preliminary stage of a state plan for development and implementation of CBAE. North Dakota has had several noteworthy activities in an instructional materials clearinghouse and homebound instruction. Louisiana has provided important research into the adaptation of APL for use in traditional programs, and Illinois and Florida have both evolved models for staff development in CBAE. Many other states have recently supported projects that have expanded the CBAE focus to special adult groupings; high school diploma alternatives; instructional/staffing alternatives; and linkage with CETA, Aid to Dependent Children, vocational-technical programs and community colleges.

#### STAFF DEVELOPMENT FOCUS

Key emphasis in these new state and local endeavors has been the development of a program and a "people" commitment to the CBAE effort through staff development activities. Until personnel can both support and perform the CBAE process, administrative efforts towards CBAE will require enormous energy with little positive outcome. Staff development activities must incorporate the following elements:

1. **AWARENESS** - Staff must have both knowledge and attitudes that reflect the CBAE process. Most staff development programs have some form of presentation of key features of CBAE, differences between CBAE and traditional approaches, and discussions of current learner needs as they relate to functional skills. This level is primarily concerned with gaining understanding, positive attitude, and a commitment to learning about CBAE.
2. **KNOWLEDGE** - This level is focused upon content and skills sessions dealing with concepts of functional literacy, competency-based processes, learner outcomes, individualization, personalization, assessment and counseling.

086

OUTLINE OF INSTRUCTION

c. Solder finish

(1) Bright gleaming appearance

(2) No pits or holes

d. Wetting

(1) Solder flow to edges of pads

(2) Solder blends into surface  
with no ridges.INSTRUCTOR ACTIVITY

c. Show slide

d. Show slide

STUDENT ACTIVITY

086

1085

1086

564

4-1-11

high school diploma model appropriate to state/local requirements. These costs appear to be a significant investment. What is not apparent, however, is the positive impact of CBAE in relation to the ongoing costs of a program. As will be presented in the research section, several studies have demonstrated that CBAE programs generally have a higher retention rate of students than traditional instructional programs have. The New York External High School Diploma Program reported only a 19.5 percent dropout rate from completion of the diagnostic process through the award of the diploma. The APL project reported an 80 percent completion rate of its diploma program in 1975-76 and a 77 percent completion rate in 1976-77 (Fischer, 1979). In addition to the higher retention rates in these diploma programs, the Louisiana comparative study of ABE students in traditional basic skills and life skills instructional settings reported a higher retention rate and greater test scores on the CAT (basic skills) for the experimental life skills instruction group (Fischer, 1979).

Although it is impossible to document differences statistically, the CBAE approach could cut down the time and effort formerly required in certain types of instructional activities. These savings would be due in part to the focus on assessing current student level in skill and content areas and providing a more accurate matching of curriculum with learner level. Also, the instructional approach provides opportunities for students to learn from the community, friends, and family beyond the classroom environment in a focused learning effort. Thus learners can be more independent of the traditional instructional classroom activities. In addition, the CBAE system is a performance outcome system that can be easily communicated in public relations efforts, can be modularized to link with other programs serving disadvantaged adults, and can thus be incorporated into other forms of services that rely on external funding, such as CBTA.

Other administrative concerns surround the open entry/open exit, individualized instruction, and competency assessment orientation. These areas of CBAE do not fit into traditional practices of adult basic education programs. For example, present data collection procedures assume a grade level orientation. State and federal report forms require categorization of student participation and their progress through grade skill-level criptors. CBAE programs do not conform to these programmatic requirements. Fiscal accountability is another difficult area to translate into a CBAE framework. When a local or state program requires an ADA (average daily attendance) or quarterly or yearly count of student numbers, reporting difficulties are bound to occur because the CBAE system does not hold traditional classes of a certain duration. Thus, matching up financial support with documentation of instructional activity

565

OUTLINE OF INSTRUCTION

e. Solder defects

- (1) All connection free of solder defects covered in lesson on high reliability soldering.

C. Characteristics and handling of micro-miniature circuitry

1. Circuitry characteristics

- a. There are many characteristics of electronic circuitry used today which require that technicians performing repair possess exceptional skill

INSTRUCTOR ACTIVITY

C: Display slide YXP-L2-S4

STUDENT ACTIVITY

1058

1087

## CURRENT STATE OF RESEARCH IN COMPETENCY-BASED ADULT EDUCATION

From the first definition of functional literacy and competency-based programming to the development of the New York External High School Diploma Program in 1973 and the official research findings of the APL Project in 1975, adult educators have raised a series of questions concerning CBAE. At this time, three major questions surround the nature of CBAE and its future implications for practice.

### WHAT IS COMPETENCY?

One key question focuses upon the nature of competency. As noted by Fischer (1979) in her discussion of approximately sixteen studies, a variety of studies have examined both the APL and alternative definitions of functional competencies for adults. The outcome of these sixteen state and regional studies, though limited, brings no consensus on one specific, finite list of adult functional competencies. Rather, it notes some similarities among certain functional skills thought to be needed by adult population groups. Other studies note various differences in perceptions among teachers, students, and administrators in defining necessary functional competencies. These studies also note student differences in priority ranking of competency needs and the relationship between basic skills and life skills. This variability is well described by studies in New Jersey (Flaherty, 1977, 1978), Pennsylvania (Lindsay and Neid, 1977; Lindsay, n.d.), and the Southeast (Fisher, 1978). Each study requested the participating groups to rank the five APL knowledge areas. The Pennsylvania study of students and staff noted a general agreement that occupational knowledge was of greatest importance; consumer economics was rated next in importance. The Flaherty study

089 OUTLINE OF INSTRUCTION

- b. The first characteristic is the minute size of components and associated circuitry.

(1) Size is one of the most common factors requiring special skills of the repair technician since a microscope must often be used to perform the work.

(2) Size alone, however, is far from being the only characteristic requiring special repair skills.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

089

089

090

566

a competency-based instructional effort. Until major research funding is directed toward examining alternatives of competency assessment and their relative impact and value in a CBAE instructional effort, these serious dilemmas will continue.

#### IMPACT OF CBAE

The impact or effect of CBAE instruction is the third major concern for researchers and for adult education practitioners. Due to CBAE's new status, there are obvious concerns for the Hawthorne effect in evaluating CBAE instructional effectiveness. However, as reported by Fischer (1978, 1979), programs in Louisiana, New England, Illinois, Alabama, and New Hampshire each reported positive and significant gains in student APL Survey performance after CBAE instruction. Louisiana reported that the gains on both basic skills and the APL life coping skills were significantly higher for those students receiving APL instruction as opposed to a control group receiving traditional ABE instruction (Fischer, 1979b). Fischer also notes key qualitative data in CBAE instructional efforts. Students reported they "felt more capable and confident in handling various life situations" (Fischer, 1979). Further as reported by Louisiana, New York, Texas, and Iowa, students in life skills instruction had a higher rate of retention than did those in general basic skills tracks.

These three basic questions facing CBAE research speak to the current state of the art. CBAE has only been in existence for a few years, and much of the present activity is relatively recent. While there is preliminary evidence to support the value of functional competency and relevance in a CBAE approach, these three serious questions will have strong, significant effects on the future of CBAE as an efficient and effective total instructional process.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>c. Another common characteristic is conformal coatings which are extremely difficult to remove. This situation often requires skill well above average to remove the coating without causing damage to components and associated circuitry on the workpiece.</p> <p>d. Components which are highly susceptible to various types of damage are a characteristic of micro-electronics. Components in this category require replacement. Solder characteristics are the same as for miniature soldering.</p> <p>e. Circuit board laminates often require above average skills of repair technicians due to size, damage susceptibility, or complexity.</p>		<p>567</p> <p>1092</p>

1091



administrative and instructional practices to support a CBAE function.

Because of its relatively new status, research has examined the nature, scope, and impact of CBAE to only a limited degree. Most of the studies have attempted to define and specify functional competencies or have examined the impact of CBAE on student skills and retention. At this time, only a generalized set of commonly perceived functional competencies exists along with a wide variety of other specialized competencies unique to the learner, geographic region, or research focus. Studies investigating CBAE impact have generally noted significant positive gains on life coping skills tests and higher retention rates than those achieved by students in basic skills instruction.

Competency-based adult education presents a range of new and enriched opportunities in adult basic education programs. The many facets of CBAE processes and structure will require the development of a practitioner-researcher partnership. The next ten years should witness the implementation of innovative and effective instructional strategies for adult learners.

341

OUTLINE OF INSTRUCTION

- f. Another circuit characteristic which requires micro-electronic level repair skills, although the circuitry and components are not "micro-electronic" as such, is high density packaging of standard discrete components.
- g. A final characteristic and the one generally requiring the most skill to perform repair, is that of extensive workpiece damage.
- (1) When extensive workpiece damage exists, the repair is often more of a manufacturing process than a repair process. For this reason a great deal of skill is required of the repair technician when repairing extensive damage.

093

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

093

1094

568

New Bedford Adult Diploma Program  
Mr. John Borowicz, Director  
181 Hillman Street  
New Bedford, MA 02740  
617-999-3012

Competency Based Adult Diploma Program  
Ms. Colleen Owings  
Chemeketa Community College  
P.O. Box 14007  
Salem, Oregon 97309  
503-399-5093

New York External High School Diploma Program  
Ms. Judy Alampres  
Regional Learning Service of New York  
405 Oak Street  
Syracuse, NY 13202  
312-425-5252

CBAE-ABE Programs

Dr. Sherry Royce  
1110 Enterprise Road  
East Petersburg, PA 17520  
717-569-7331

Worcester Adult Learning Center  
014 Worcester Center  
Worcester, MA 01608  
617-752-7700

Helen Borque  
Saco Adult Learning Center  
35 Spring Street  
Saco, Maine 04072

Mary Jo Westwood  
Columbia Public School Adult Learning Center  
310 Providence Road  
Columbia, MO 65201  
314-449-8421

CBAE-ESL Programs

Ms. Autumn Keltner  
ABE/ESL Programs  
Adult and Continuing Education  
San Diego Community College District  
5350 University Avenue  
San Diego, CA 92105  
714-280-7610

### OUTLINE OF INSTRUCTION

(2). This type of repair action also requires, in most cases a number of special materials which are not generally available to the average repair technician.

- h. Beside the requirements for special skills, many of the characteristics of micro-electronic circuits also necessitate the use of special tools. The delicacy and expense of these tools preclude their distribution to any but a select few highly trained and skilled repair technicians.

### 2. Proper handling techniques

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

569

1096

1095

Dr. Ruth Nickse  
58 Monmouth Street  
Brookline, MA 02146

Dr. Carol Kasworm  
Department of Curriculum and Instruction  
University of Texas  
Austin, Texas 78712  
(512)-471-4285

B. Competency-Based Adult Education Bibliographies or Products Listings

1. Division of Adult Education  
U.S. Department of Education  
Washington, D.C. 20202  
(Resources for Adult Functional Competency)
2. National Adult Education Clearinghouse  
National Multimedia Center  
Montclair State College  
Upper Montclair, NJ 07043  
(CBAE Bibliography--both background and curricular materials)  
(The CB Reader - A Guide to Understanding the Competency-Based Adult Education Movement. Price \$7.00; including \$1.00 handling)
3. Adult Education Center  
School of Continuing Education  
Indiana University of Pennsylvania  
Indiana, Pennsylvania 15705  
Bibliography of Adult Performance Level (APL) Resources)
4. Clearinghouse for Applied Performance Testing  
Northwest Regional Educational Laboratories  
710 SW Second Avenue  
Portland, Oregon 97204  
(Annotated Bibliography of Applied Performance Testing and an Annotated Bibliography on Minimum Competency testing)
5. I.C.E.D.S. Project  
5350 University Avenue  
San Diego, CA 92105  
(Competency-based curriculum materials - HEARTBEAT newsletter, sourcebook on functional competency materials)

602

# OUTLINE OF INSTRUCTION

## INSTRUCTOR ACTIVITY

## STUDENT ACTIVITY

- a. To avoid workpiece damage, constant attention and care must be given to handling procedures both before and after the repair process, as during the repair process.
- b. During the repair process particular attention must be given to the use of proper repair techniques to avoid causing damage to components or circuits.
- c. During all stages of handling remember that someone's life generally depends upon the proper functioning of the workpiece you are repairing.

1098

097

5147-5149P9

4-1-17

570

Clovis Adult School, 914 Fourth Street, Clovis, CA 93612; (5) APL-ACT Survey instruments and content area measures. Contact: The American College Testing Program, APL Department, P.O. Box 168, Iowa City, Iowa 52240.

#### RESOURCE READINGS IN CBAE

1. Adult Performance Level Staff. Adult Functional Competency-Final Report. Austin, Texas: University of Texas, August, 1977.
2. Parker, J. and Taylor, P. (Eds.) The CBAE Reader: A Guide to Understanding Competency-Based Adult Education, February, 1980. (Eleven articles on CBAE - what it is and how to do it.) Order from - Adult Education Clearinghouse National Center for Adult Continuing Education Montclair State College Upper Montclair, NJ 07043
3. Issues of Adult Literacy and Basic Education (203 Petrie Hall, Auburn University, Auburn, AL 36830). Key Issue: Fall, 1979, Volume 3, No. 3: ten articles on various programs, research and application of CBAE. Past issues have had excellent articles on APL and its applications.
4. Boulmetis, John. Competency-Based Adult Vocational Instruction: What Is It? California: Fearon-Pitman, 1980.
5. Kasworm, Carol E. & Duddy, R. Lyle. Proceedings of a National Invitational Workshop on Competency-Based Adult Education. Austin, Texas: University of Texas, 1979. (Overview discussion of component programs in CBAE, Administrative, Research, and Overview issues)
6. Nickse, Ruth S. Assessing Competence: The External High School Diploma. California: Fearon-Pitman, in press.
7. Nickse, Ruth and McClure, Larry (eds.). Competency-Based Education: Beyond Minimum Competency Testing. New York. Teacher's College Press, in press.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
III. <u>APPLICATION</u> - NONE		571
IV. <u>SUMMARY</u>		
A. Introduction	A. Emphasize importance of the summary for the student.	
1. Nature of summary		
2. Purpose of summary		
B. Directions to students		
1. Questions		
1099		1100



## REFERENCES

- Adkins, W.P. Where They Hurt: A Study of the Life Coping Problems of Unemployed Adults. New York, New York: Columbia University Press, 1977.
- Adler, L. "Designing Competency-Based Learning Centers." Adult Literacy and Basic Education. 3(Spring, 1979): 179-184.
- Adult Functional Competency Final Report. Austin: University of Texas, Adult Performance Level Staff, 1977.
- Berg, I. Education and Jobs: The Great Training Robbery. Boston, Massachusetts: Beacon Press, 1971.
- Bureau of Adult, Continuing and Community Education of New Jersey. Competency Based Adult Education: An Organized Approach to Effective Programming in New Jersey. Upper Montclair, New Jersey: State Department of Education, Resource Dissemination Center, Montclair State College, n.d.
- Cervero, R.M. "Does the Texas Adult Performance Level Test Measure Functional Competence?" Adult Education. 30(Spring, 1980): 152-165.
- Cook, W. Adult Literacy Education in the United States. Newark, Delaware: International Reading Association, 1977.
- Darkenwald, G.C. "Some Effects of the 'Obvious Variable': Teacher's Race and Holding Power with Black Adult Students." Sociology of Education. 48(Fall, 1975): 420-431. (EJ 136 888)
- Dauzat, S.V. Adult Performance Level Research and Curriculum Design. Ruston: Louisiana Tech University, College of Education, 1978a. (ED 162 110)
- \_\_\_\_\_. Louisiana Adult Performance Level Pilot Study: A Comparative Study of APL Competency-Based Instructional Programs. Final Report. Ruston: Louisiana Tech University, College of Education, 1978b. (ED 154 129)
- Fiscal Year 1979 Findings for Adult Functional Competency Projects. Washington, D.C.: U.S. Office of Education, Division of Adult Programs, n.d.
- Fischer, J.K. "A Review of Competency-Based Adult Education." Report of the USOE Invitation Workshop on Adult Competency Education. Washington, D.C.: U.S. Government Printing Office, 1978. (ED 013 371)

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
2. Notes		
C. Recap of lesson	C. Emphasize safety	C. Ask question if material not clear; check notes to insure accuracy and completeness.
V. <u>INFORMAL TEST</u>		
A. There is not informal test for this lesson topic.		
VI. <u>ASSIGNMENT</u>	VI. Provide students with the homework assignment.	VI. Ask questions if the assignment is unclear. * Complete assignment.

- \_\_\_\_\_ and Nead, B.M. "APL and ABE in Pennsylvania: Performance Acceptability and Promise." Notes on Adult Education. University Park: The Pennsylvania State University, 1977.
- Mann, T.W. Competency-Based Education Using the APL Functional Competency Measure to Aid the Adult Learner. Iowa City, Iowa: American College Testing Program, 1979.
- McCune, D.A. "The California Adult Competency Survey: A Preview and Analysis of National Implications." Adult Literacy and Basic Education. 3(Fall, 1979): 211-216.
- Messick, S. and Associates. Individuality in Learning. San Francisco, California: Jossey-Bass Publishers, 1976.
- Mezirow, J. et al. Last Gamble on Education: Dynamics of Adult Basic Education. Washington, D.C.: Adult Education Association of the U.S.A., 1975.
- Michigan Life Role Competencies. East Lansing: Michigan Department of Education, 1977.
- National Advisory Council on Adult Education. A Target Population in Adult Education. Washington, D.C., 1974.
- Nickse, R.S. Assessing Life-Skills Competence. Belmont, California: Pitman Learning, 1980.
- \_\_\_\_\_ and McClure, L., eds. Competency-Based Education: Beyond Minimum Competency Testing. New York, New York: Teacher's College Press, 1979.
- Niles, T. Personal communication with the author. February 28, 1980.
- NOMOS Institute. Adult Competencies: Categories and Specific Statements. Berkeley, California, 1978.
- \_\_\_\_\_. California Adult Competency Survey. Final Report. Berkeley, California, 1979.
- Nyer, L. "Research Issues in Competency Based Adult Education." Proceedings of a National Invitational Workshop on Competency-Based Adult Education. Austin: University of Texas, 1979.
- Pierce, R.B. "Competency-Based Adult Education in Correctional Institutions: State of the Scene." Adult Literacy and Basic Education. 3(Fall, 1979): 229-233.
- Pipho, C. "Minimum Competency Testing in 1978: A Look at State Standards." Phi Delta Kappan. 59(May, 1978): 585-588. (EJ 177 667)

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

Lesson Topic 4.2:  
Microminiature Repair Task Identification and Procedural Analysis

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 3.0 Hours  
Laboratory - 0.0 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides YXP L-5S1 through YXP L5-S90

3. Training Aids Equipment

- a. Projector, Slide
- b. Screen, Projection, Standard

4. Text

- a. Student's Guide

5. Reference

- a. Volume 6, PACE Rework and Repair Technology Series

TERMINAL OBJECTIVES

- 6.0 REPLACE component parts on micro-electronic printed circuit boards using the correct tools and soldering techniques and APPLY the proper conformal coating in accordance with the procedures and to the standards outlined in MIL-STD 454D.
- 7.0 REMOVE conformal coatings from micro-electronic printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.
- 8.0 REMOVE micro-electronic printed circuit board components parts using the correct tools and desoldering techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.

### ENABLING OBJECTIVE

When you complete this lesson topic, you will be able to:

- 4.2.1 IDENTIFY the repair task of various types of micro-electronic circuit boards by visual inspection and procedural analysis of selected micro-electronic circuits. Identification will be in agreement with the connections listed in Volume 6 of the PACE Rework and Repair Technology Series.

### CRITERION TEST

Given selected micro-electronic circuit boards the student will be required to identify by visual inspection and procedural analyses the repair tasks to be performed during the remainder of the course. Identification will be in agreement with the connections in Volume 6 of the PACE Rework and Repair Technology Series with minimum degradation to the circuit boards.

### HOMEWORK

Read and study Notetaking Sheet 4-2-1n of the Student's Guide



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Accomplishment of daily tasks aboard ship.
2. The necessity of the skills and techniques in repair of printed circuit boards.
3. Personal applications of the knowledge and skills.

Seek to motivate. Tell a good tie-in story if possible.

576

1103

1108

4-2-4

9390-91P1

OUTLINE OF INSTRUCTION

C. Effect

D. Overview

INSTRUCTOR ACTIVITY

C. When following a subject matter lesson topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).

2. Commend students for mastery of skills in previous lesson(s).

D. Overview lesson by:

1. Stating learning objectives as contained on cover pages to this topic.

STUDENT ACTIVITY



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

2. Stating procedures to be followed during the lesson.

a. Taking notes.

b. Asking questions.

c. Use of criterion test.

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives on procedures if in doubt.

598

1113

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>II. <u>PRESENTATION</u></p> <p>A. Circuit Board Construction</p> <p><u>NOTE:</u> Only those construction details which you have not learned in previous training will be covered in this lesson.</p> <p>1. Extremely high density circuits</p> <p>a. One category of module you will be required to work on, in micro-electronics repair, is the type which uses standard circuitry and discrete components, but is constructed using extremely high density component packaging.</p>	<p>A. Display slides and explain C/B construction.</p>	<p>A. Follow lesson taking notes and ask questions if necessary.</p>

1114

4-2-7

1115

579

OUTLINE OF INSTRUCTION

- (1) The use of standard packaging. Unless other complications of construction such as thick coating or welded leads exists, this is not a micro-miniature repair task.
- (2) Both standard and high density packaging may be a microminiature repair task if failure occurs in a high density area.
- (3) High density packaging - with the very thick conformal coating used on some modules, combined with the density of packing, makes it a micro-miniature repair task

1116

INSTRUCTOR ACTIVITY

- (1) Display slide YXP L5-S2.
- (2) Display slide YSP L5-S3.
- (3) Display slide YXP L5-S4.

STUDENT ACTIVITY

1117

OUTLINE OF INSTRUCTION

(4) The extremely high density packaging and epoxy potting used on submodules makes it necessary to use micro-miniature repair techniques on a submodule even though it uses only discrete components.

(5) Assorted high density modules

(a) The square module uses extremely high density packaging and has many memory unit submodules. This module should be repaired with micro-miniature techniques

INSTRUCTOR ACTIVITY

(4) Display slide YXP L5-S5.

(5) Display slide YXP L5-S6

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

- (b) The three long rectangular modules use high density packaging but will not normally require microminiature repair techniques
- (c) The black micro-circuit is actually a hybrid submodule. It has an integrated circuit (IC) chip in the top and micro-miniaturized discrete components, with welded leads, potted into the bottom. The discrete components may be replaced but it is definitely a micro-miniature repair task.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

582

1120

1121

OUTLINE OF INSTRUCTION

- (d) The "flat-pack" IC circuit itself is not repairable. It should only be changed with micro-miniature techniques

2. Hybrid circuits

- a. A hybrid circuit is one which contains both discrete components and micro-circuits
- b. Hybrid circuits are a second category which require the use of micro-miniature repair techniques

INSTRUCTOR ACTIVITY

- 2. Explain the construction of the various hybrid circuits.

STUDENT ACTIVITY

1123

583

1122

4-2-11

9392-93P1

OUTLINE OF INSTRUCTION

c. The following describes typical examples of hybrid circuits and their construction

(1) A hybrid contains a combination of discrete components and IC submodules. The submodules, in turn, are also a form of hybrid circuit.

(2) Submodules should be removed or replaced only with micro-miniature techniques

(3) A ceramic printed circuit (CPC) is hybrid since it contains both thin film circuitry and discrete components.

INSTRUCTOR ACTIVITY

(1) Display slide YXP L5-S7.

(2) Display slide YXP L5-S8.

(3) Display slide YXP L5-S9.

STUDENT ACTIVITY

584

1124

1125

OUTLINE OF INSTRUCTION

- (4) Hybrid CPC with all discrete components lap soldered to module.

- (5) A CPC which contains both IC chips and discrete components.

INSTRUCTOR ACTIVITY

- (4) Display slide YXP L5-S10.

NOTE: The the components which appear to be flat pack ICs have only six leads. These are actually not ICs but two transistors in a single can.

- (5) Display slide YXP L5-11.

NOTE: The large blocks are monolithic capacitors. The circuit size is about 1½" by ¾" and is equivalent to a medium scale integration (MSI) IC.

STUDENT ACTIVITY

1126

1127

585



OUTLINE OF INSTRUCTION

- (6) The circuit board, contains a combination of IC chips and discrete components.

3. CPCs

- a. The majority of CPCs are hybrid circuits using both film (thick or thin) and discrete components

1128

INSTRUCTOR ACTIVITY

- (6) Display slide YXP L5-S12.

3. Explain that the following series of slides will show some typical examples of CPCs and describe their construction.

4-2-14

STUDENT ACTIVITY

586

1129

### OUTLINE OF INSTRUCTION

(1) Alumina is a substrate ceramic material which has a very high thermal conductivity, low dielectric loss even at high frequencies, and can withstand very high temperatures. The substrates used are from 0.010" to 0.035" thick.

(2) Typical thin film circuits

(a) Thin film is a term used to denote the method by which film circuitry (conductive, resistive, or dielectric ink) is applied to the substrate

### INSTRUCTOR ACTIVITY

(1) Display slide YXP L5-S13.

(2) Display slide YXP L5-S14

### STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

(b) Thin film circuitry is deposited in a vacuum-by-vacuum deposition (vaporizing material in a vacuum at 200 degrees to 400 degrees C) or cathode sputtering (using an electric potential to discharge material into a vacuum)

(c) The conductor film thickness is 10,000 to 30,000 Angstroms (25,000 A = 0.0001") and the width is 0.005" to 0.020"

(3) The film circuit closeup

INSTRUCTOR ACTIVITY

(3) Display slide YXP L5-S15

STUDENT ACTIVITY

588

1132

1133

9394-95P1

4-2-76

OUTLINE OF INSTRUCTION

- (a) The yellow areas are insulating layers
- (b) The thin dark lines are resistors
- (c) Thin film circuits are dip soldered with a thickness of 0.0005" to 0.002"
- (d) When finished, thin film circuits are coated with powdered glass (fired at low temperature) or polyurethane

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

(5) First construction step  
of thick film CPC

(a) The first layer of  
conductors and insula-  
tion has been screened  
on a fused to the  
substrate

(b) Conductors are platinum  
and gold paste fired  
in an oven at  
approximately 1600  
degrees F

INSTRUCTOR ACTIVITY

(5) Display slide YXP L5-S17.

STUDENT ACTIVITY

590

1137

OUTLINE OF INSTRUCTION

(6) Second step of thick film  
CPC construction

(a) A layer of high density  
carbon ink screened on  
and fused to the circuit  
to form resistors

(b) The resistive ink is  
fired at approximately  
1200 degrees F.

(7) Third step of thick film  
CPC construction

INSTRUCTOR ACTIVITY

(6) Display slide YXP L5-S18

(7) Display slide YXP L5-S19.

STUDENT ACTIVITY

ED193529

PREPARING HUMAN SERVICE  
PRACTITIONERS TO  
TEACH OLDER ADULTS

written by

Roger Hiemstra  
Iowa State University

The ERIC Clearinghouse on Adult, Career, and Vocational Education  
The National Center for Research in Vocational Education  
The Ohio State University  
1960 Kenny Road  
Columbus, Ohio 43210

1980

CE 027 092

U.S. DEPARTMENT OF HEALTH  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

OUTLINE OF INSTRUCTION

(a) The resistors are trimmed away until the proper value is attained

(b) These trimmed areas can be seen as notches in the black material

(8) Trimming CPC components

(a) The machine used is a microminiature air abrasive (sandblasting) machine

INSTRUCTOR ACTIVITY

(8) Display slide YXP L5-S20.

STUDENT ACTIVITY

592

1140

1111



## FUNDING INFORMATION

**Project Title:** ERIC Clearinghouse on Adult, Career, and Vocational Education

**Contract Number:** NIE-C-400-76-0122

**Educational Act Under Which the Funds were Administered:** 41 USC 252 (15)  
and PL 92-318

**Source of Contract:** U.S. Department of Education  
National Institute of Education  
Washington, D.C.

**Contractor:** The National Center for Research in Vocational Education  
The Ohio State University  
Columbus, Ohio

**Executive Director:** Robert E. Taylor

**Project Director:** Juliet V. Miller

**Disclaimer:** This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Education. Contractors undertaking such projects under government sponsorship are encouraged to freely express their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official National Institute of Education position or policy.

**Discrimination Prohibited:** Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance."  
Title IX of the Education Amendments of 1972 states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal assistance." The ERIC Clearinghouse project, like every program or activity receiving financial assistance from the U.S. Department of Education, must comply with these laws.



This publication was prepared with funding from the National Institute of Education, U.S. Department of Education, under Contract No. NIE-C-400-76-0122. The opinions expressed in this report do not necessarily reflect the position or policies of NIE or the Department of Education.

OUTLINE OF INSTRUCTION

(b) Recently some manufacturers have also begun to use a laser for the trimming operation

(9) Plated-through holes on CPC for double-sided use.

(10) Typical operational thick film CPC package which is about 3/4" square

(11) Operational CPC package with top removed

INSTRUCTOR ACTIVITY

(9) Display slide YXP L5-S21.

(10) Display slide YXP L5-S22.

(11) Display slide YXP L5-S23.

NOTE: The leads from circuit to exterior connections and from circuit to discrete components

STUDENT ACTIVITY

## ABSTRACT

This paper overviews existing research on how one teaches the older person. It is aimed at the many persons who work with older adults, regardless of whether they are trained to teach older adults. Suggestions are outlined for the design and implementation of effective education for older persons. Several areas that are examined are (1) the history of adult learning (includes models, stages, and theories; memory and intellect; and learning needs and obstacles); (2) the adult education instructor (includes the teacher as facilitator; the teaching/learning process; and self-directed learning); (3) techniques of altering traditional modes of dispensing information and developing personal instructor approaches and styles (discusses interference, hesitancy, speed and pacing, and organizational and associational abilities); and (4) the need for further research. Appended materials contain some anecdotal experiences related to working with older adults and a list of relevant resources such as periodicals, professional associations, political groups, and professional training opportunities. (CT)

DESC: \*Educational Research; \*Older Adults; \*Adult Educators; Program Design; Program Implementation; \*Teaching Methods; \*Educational History; Literature Reviews; Educational Theories; Needs Assessment; \*Learning Problems; Learning Processes

OUTLINE OF INSTRUCTION

(12) Closeup of operational CPC package

(a) Shown are transistor chips, gold alloy circuitry, and a screened resistor. The chips are scrub-bonded to the circuitry by ultrasonic soldering

(13) CPC submodule with aluminum cover

(14) CPC submodule with cover removed

INSTRUCTOR ACTIVITY

(12) Display slide YXP L5-S24.

(13) Display slide YXP L5-S25.

(14) Display slide YXP L5-S26.

STUDENT ACTIVITY

594

1115

## TABLES

TABLE 1	A SUGGESTED TEACHING/LEARNING PROCESS FOR ADULTS; PLANNING ELEMENTS AND METHODOLOGICAL IMPLICATIONS	13
TABLE 2	GUIDING THE OLDER ADULT LEARNER: SUGGESTIONS FROM THE LITERATURE	18

OUTLINE OF INSTRUCTION

- (a) The circuit contains four screened resistors and three scrub-bonded transistors.

(15) More complex CPC submodule

4. Multilayer printed circuits

- a. Multilayer printed circuits are used widely in current systems to reduce the size and space taken up by interconnection wiring

1146

INSTRUCTOR ACTIVITY

(15) Display slide YXP L5-S27

4. Describe the construction of multilayer printed circuits

STUDENT ACTIVITY

1147

595

However, as indicated, it is not possible to cover in depth every issue of importance to the teaching/learning process. The paper, nevertheless, should be useful to many persons (i.e., those who are trained or untrained, skilled or unskilled) who work with older adults. The intended audience is the "human services practitioner." Admittedly, this is a broad term designed to cover a variety of people such as social workers, extension specialists, librarians, leisure service providers, volunteer workers, counselors, and aging network employees. It is assumed that many of these individuals will not have had much, or in some instances, any, professional training for working with older persons. An effort will be made, therefore, to outline in practical terms what can be suggested from the research regarding the design and implementation of effective education for older persons. Hopefully, enough resources will be provided to stimulate readers toward further study. In addition, adult educators, educational gerontologists, and a variety of researchers also should find the paper useful in providing an interpretational base of information. Such audiences can further this base by challenging or substantiating points made throughout the paper.

Before we turn to the literature, however, several initial points should be made. In terms of definitions, the healthy older adult, the biggest percentage of all people over age sixty-five, is primarily what the author has in mind when making suggestions about teaching. Frail, institutionalized, or handicapped adults obviously serve as research subjects in many instances, but special care and expertise often confound any needed teaching and learning interaction. (For example, see anecdotes in Appendix A.) Thus, the assumption is made that older adults are capable of learning, are willing to learn under the right conditions, and will benefit from good teaching and learning.

Lastly, in terms of some general problems of teaching older adults, many persons who find themselves in a situation of needing to organize some sort of learning activity for older persons have had no formal preparation for teaching, especially teaching adults. Therefore, directing a pre-retirement planning program, delivering nutrition information at a congregate meal site, or instructing a group of elderly on how to fill out governmental forms often must be done by instinct, trial and error, or modeling from past experiences. Another problem centers around how to organize and present necessary information to insure maximum learning. Questions about appropriate teaching techniques, learning inhibitors, how to structure learning experiences, and how to evaluate progress continue to be raised. Still another problem facing many people who attempt to conduct learning experiences centers around defining the role of the

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- b. Multilayer boards are made up of a series of very thin conducting and insulating layers which are laminated together to form a single circuit board.

- c. The current complexity of these boards is such that computers are generally required to layout and test their physical design

- d. The individual board layers are a double-sided circuit lamination of 0.002" copper on a 0.003" thick insulation layer

- e. These thin layers are pre-impregnated with epoxy and then laminated together with heat and very high pressure

596

1149



## THE OLDER ADULT AS LEARNER

### OLDER ADULTS CAN LEARN

The history of knowledge about adult learning capacity reads like the pioneering efforts that have been basic to the western world, that is, the frontiers constantly get pushed further out. Thorndike's (1928) pioneering efforts resulted in a frontier that pointed with optimism to only a gradual decline in learning ability until age forty-five, at which time a sharp decline could be expected. More comfort was found in Jones and Conrad's (1933) famous Army Alpha Test research which showed that the gradual decline continued until age sixty. In the 1950s longitudinal research reports began to show adult ability in a much improved light; for example, Terman and Oden (1959) demonstrated actual gains with age on some cognitive measures.

In the early 1960s, the explosion in research on the older adult began. Most of the earlier studies and some of those in the 1960s were tied to stimulus-response (S-R) notions regarding human behavior, or what Hultsch (1977) called the "associative" model. In this model, learning and memory were believed to be tied to responses to learning stimuli; differences in age group were associated with various types of interferences.

The next evolutionary change began to emerge in the early to mid-1960s, when notions about the human organism were inserted into the older S-R model. McClusky (1971) described the Stimulus-Organism-Response (S-O-R) formula as the key that unlocked the door to communicating and interacting with learners. Hultsch (1977) referred to this as the information processing model. Based on notions about learning as the intake

### OUTLINE OF INSTRUCTION

f. There are three different methods commonly used to make inter-connections-between conducting layers

g. Multilayer board interfacial connection style

h. 18-layer MLPCB mother board

i. 18-layer MLPCB with connector installed.

j. Back-lighted view of 18-layer MLPCB

### INSTRUCTOR ACTIVITY

NOTE: Multilayer printed circuits are to be repaired only by full microminiature repair technicians, graduates of NAVAIR two week course.

g. Display slide YXP L5-S28.

h. Display slide YXP L5-S29.

i. Display slide YXP L5-S30.

j. Display slide YXP L5-S31.

### STUDENT ACTIVITY

## MODELS, STAGES, AND THEORIES

In short, a variety of research exists that relates in some manner to models, stages, and theories about how adult learning takes place. It often is difficult to determine exactly how each researcher is referring to the learning process in relationship to others who also describe learning activity. In fact, there appears to be considerable disagreement in terms of capabilities, limitations, and the exact nature of learning.

Some earlier theories about older adults as learners have been proven wrong or else have evolved as a result of additional knowledge or longitudinal research. A disengagement theory, or the increasing separation from activity with age, was a popular notion during the 1950s and 1960s (Cumming and Henry, 1961; Cumming, 1963). As Moody (1976) suggested, this approach characterized the social services era of "fixing" problems largely through the intervention of public policy and transfer payments. A better understanding of older adults has led to a fairly wide-spread dismissal of the disengaging notion and replaced it with concepts on compensating, adapting, and activity abilities. (E.g., see R.D. Gordon, 1974; Labouvie-Vief, 1977; Olbrick and Thomae, 1978; Palmore, 1970).

## MEMORY AND INTELLECT

A number of studies on older persons report a slow decline in intelligence with age (Jones, 1979). The Weschler Adult Intelligence Scale has been used by many researchers. While this test utilizes verbal response answers based on accumulated knowledge and vocabulary, the older person probably is penalized because of built-in time constraints (Levine, 1971). Hence, once the speed factor is removed, many researchers believe that intelligence change is not age related (Bolton, 1978). In fact, some studies have shown little loss and some actual gain in related tests of vocabulary, general information, verbal reasoning, experience, and judgment with age (Jones, 1979). Given good health, highly mentally active adults tend to stay that way throughout their life (Botwinick, 1977). As McClusky (1973) reminds us, individual differences exist among people regardless of age. Thus, later life intelligence is better characterized by plasticity or flexibility rather than by universal decline (Labouvie-Vief, 1976).

"The jury is still out" in terms of memory ability. Botwinick (1967) and Catino et al. (1977) have found some short term

OUTLINE OF INSTRUCTION

k. Dissected MLPCB

l. Internal view of post construction MLPCB

5. Flexible printed circuits

a. Flexible printed circuits are a fairly recent development in circuit technology

b. Flexible circuits are highly reliable and seldom need repair. When repair is needed, the complexity and materials required demand the microminiature repair techniques be used.

INSTRUCTOR ACTIVITY

k. Display slide YXP L5-332.

l. Display slide YXP L5-333.

STUDENT ACTIVITY

598

153

A variety of health-related factors and a person's overall health status also appear to affect learning ability and activity. Fatigue, for example, can be a problem as Gounard and Hulicka (1977) noted. Perceptions by older persons of declining energy or health as a barrier have been reported by Hiemstra (1972, 1975). Agruso (1978), Knox (1977, 1978), and Verner and Davison (1971) each have described the effects of declining vision and hearing capabilities on learning. Wilkie and Eisdorfer (1971) mentioned hypertension as a possible inhibitor.

It is important, therefore, that teachers understand the relationship of such factors as real needs, potential obstacles, and various health factors to the learning endeavors of older persons. McClusky (1973) theorized that people have certain reserves or margins of power available to overcome loads they encounter. The skillful teacher, however, needs to be sensitive to such loads becoming too great. Birren (1969) suggested that the elderly often recognize their needs to conserve energy and maintain supportive levels of health. Bolton (1978), however, pointed out the need for additional research on this issue.

OUTLINE OF INSTRUCTION

- c. Flexible printed circuits are constructed of a copper-conducting layer laminated between two layers of polyimide plastic film. Multilayer flexible circuits are also made using the same techniques
  
- d. Assorted flexible printed circuits

INSTRUCTOR ACTIVITY

- d. Display slide YXP L5-S50.

NOTE: Flexible printed circuits are to be repaired only by full microminiature repair technicians, graduates of NAVAIR two week course. Distribut various flexible printed circuits for student's inspection.

STUDENT ACTIVITY

Another aspect of the facilitator notion that is gaining increasing usage in terms of helping learners guide their own learning is the learning contract (Knowles, 1975; Cross, 1977). Research on the effectiveness of such contracts with older adults is still necessary. The prospective teacher may wish to explore their utility.

An additional facilitator element important to the success of teaching and learning is the evaluation of learner progress. Several researchers have cautioned against the use of traditional testing procedures. Recognition rather than recall techniques, frequent feedback on learner progress, and self- or peer-evaluation are alternative suggestions cited by Arenberg and Robertson, n.d.; Eysenck, 1975; Knowles, 1970; Mullan and Gorman, 1972. and Witte and Freund, 1976.

Another problem facing many practitioners relates to what the role of the teacher should be in the entire learning process. Historic expectations, often stemming from what such practitioners have seen modeled, have mainly focused on the belief that the dispensing of knowledge from an expert to a learner-receptor is the standard model. However, most authorities suggest that the successful teacher of adults utilizes facilitator techniques in managing the instructional process.

What is being advocated here is that the person who wishes to be a successful instructor of older adults must become a facilitator of learning, putting process before content. Expertise on some content area often takes on secondary importance. The adult educator ideally performs several functions, each of which contributes to his or her role as facilitator, for example:

- o Serves as one of several possible resources in a content area
- o Locates appropriate resources or new information as warranted by student needs
- o Arranges for and manages the successful employment of a variety of learning resources needed to accomplish certain goals
- o Stimulates learners' interest in and motivation toward certain topics
- o Helps learners develop positive attitudes toward learning and fosters their independence

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

B. Conformal Coating Compounds

1. Coatings on micro-circuits

- a. The conformal coatings you will deal with in micro-miniature repair are the same types that you learned to identify in previous training
- b. The application and removal of these coatings when repairing micro-circuits become much more critical and demand vastly increased skill level on the part of the repair technician
- c. Many times a coating may be technically defined as thin if measured, but it must be treated as a thick coat due to the relationship between coating thickness and component size

009

1157



One should also note that the process assumes that most learning endeavors will involve people primarily in group settings. However, the self-directed learner can be helped to utilize portions of the process in planning and guiding his or her own learning. Furthermore, it is anticipated that the process - or most portions of it - can be adapted to almost any type of setting.

The planning elements in Table 1 outline a logical flow of events in preparing, planning, and carrying out a learning experience. The first four elements call for an active involvement of the learner in determining relevant needs and personal goals. In a two- or three-hour session, as much as one hour might be invested in the preparatory stage. In a several-session course or workshop, the first one or two sessions might be utilized. (See Appendix A.) However, the commitment toward, and feeling of ownership for, the subsequent learning builds meaningfulness into subsequent activities that more than make up for any "lost" time. One should note, however, that the traditional instructor role of dispensing knowledge through lecture is greatly altered. Knowles (1970, 1975) and Meyer (1977) provide helpful discussions of related planning ideas, corresponding techniques, and underlying assumptions.

OUTLINE OF INSTRUCTION

- d. A thin coating on a micro-circuit which is extremely difficult to remove from around the circuit leads, must also be removed nearly 100% to enable soldering tools to properly contact the solder pad area

- e. Any conformal coating which must be removed from micro-circuit should have removal performed using only micro-miniature repair techniques due to the danger of damaging the components or work-piece

2. Extremely thick coatings

- a. Extremely thick coatings are not often encountered on circuitry using micro-miniature components unless they are completely potted or encapsulated with coating

INSTRUCTOR ACTIVITY

- d. Display slide-YXP L5-S57.

STUDENT ACTIVITY

TABLE 1 (Con't.)

PLANNING ELEMENTS	METHODOLOGICAL IMPLICATIONS
Formulate Student and Group Objectives Based on Determined Needs	<p>Provide a tentative outline of group objectives based on the needs assessed above and stated in measurable terms.</p> <ul style="list-style-type: none"> <li>o Discuss the objectives in a large group setting or facilitate small group discussion of them.</li> <li>o Revise the objectives as necessary.</li> </ul> <p>Facilitate the development of individual learner objectives in relation to the group objectives for maximum learner growth.</p> <ul style="list-style-type: none"> <li>o Use a performance contract process (Knowles, 1975).</li> <li>o Obtain a personal commitment toward and ownership of the learning necessary to meet objectives.</li> </ul>
Design and Implement the Learning Experience	<p>Promote the use of a wide variety of learning resources.</p> <ul style="list-style-type: none"> <li>o Make available instructor-developed and instructor-located materials.</li> <li>o Use outside content specialists to meet any unique needs.</li> <li>o Encourage learners to locate and provide learning resources to their peers.</li> </ul> <p>Promote self-directed inquiry and the use of resources outside the traditional learning environment.</p> <p>Help learners design appropriate experiences according to need and ability.</p> <ul style="list-style-type: none"> <li>o Match objectives (learning contracts) to appropriate resources.</li> <li>o Promote peer examination and discussion of learning contracts.</li> </ul>

OUTLINE OF INSTRUCTION

- b. You will, however, occasionally encounter micro-electronic modules with extremely thick coatings such as polyurethane coated modules.

3. Opaque coatings

- a. Opaque coatings are very common in micro-electronics circuitry
- b. Opaque coatings are generally used to completely pot or encapsulate either individual components or submodules
- c. The majority of conformal coatings are not opaque; thus, most opaque coatings are deliberately made opaque by manufacturers for one of the following reasons

INSTRUCTOR ACTIVITY

- b. Display slide YXP L5-S68.

STUDENT ACTIVITY

602

1161

## SELF-DIRECTED LEARNING

Perhaps one of the most exciting current innovations related to adult learning has been the discovery that adults of all ages--as noted above--prefer themselves as the primary planner and director of their own learning (Hiemstra, 1976a; Penland, 1979; and Tough, 1978, 1979). The selection of "self" as the primary planner also held true in some research on the older adult learner. Hiemstra (1975, 1976c) studied the learning project activity of 214 adults (age 55 and older) in Nebraska. The data show that older adults each undertook an average of 3.3 learning projects. They spent an average of 324 hours on their learning activities. Fifty-five percent of the projects were self-planned, 20 percent were group planned, 10 percent were planned on a one-to-one basis and 10 percent had no dominant type of planner. Fifty-four percent of their learning activities were self-fulfillment in nature, which included arts, crafts, recreation, and religion.

Although a great deal more needs to be known about the implications of such research for facilitators of older adult learning, several authors have offered some potentially useful advice. For example, R. D. Gordon (1974) suggested that efficiency and creative self-direction can be enhanced in older persons; Bolton (1978) indicated that "discovery teaching methods can overcome various barriers; Knowles (Symposium, 1973) urged educators to help people learn self-directed skills; Jones (1980) noted that facilitators should base learning on self-derived interests as opposed to teacher-generated assignments. A variety of non-traditional, self-directed learning modes and techniques with older adults are no doubt possible or already exist as parts of various disciplines; they await our discovery, assessment, and adaptation.

### OUTLINE OF INSTRUCTION

(1) Opaque coatings are used on highly classified circuitry as a security measure

(2) Opaque coatings are also used by manufacturers to maintain security of unique design and manufacturing processes.

(3) One of the most common uses for opaque coatings is their application by manufacturers to serve as a detriment to repair. This is done so that the circuits will be replaced rather than repaired.

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

TABLE 2

## Guiding the Older Adult Learner: Suggestions from the Literature

INSTRUCTIONAL ELEMENT	RESEARCHERS	APPLICATION SUGGESTIONS
Personal Approach of the Instructor	Gounard & Hulicka (1977) Hixon (1968) Jones (1980) Knox (1977) Mullan and Gorman (1972) Wass and West (1970)	Be positive, supportive, and helpful. Work to make the learner feel welcome. Maintain an environment of informality and levity. Help to promote learner confidence and self respect. Treat the older learner with dignity.
Sensitivity to Needs (Sensory, Physical, Perceptual)	Arenberg (1976, 1977) Gordon, R.D. (1974) Gounard & Hulicka (1977) Haase (1979) Jones (1980) Merriam (1977) Symposium (1973)	Pay attention to the physical environment.  Reduce distractions. Insure that comfortable heating and proper ventilation exist.  Be sensitive to declining vision difficulties for some learners. Insure that lots of light is available. Use high contrast on visuals and handouts. Reduce glare or direct sunlight. Use large, bold print or type. Allow time for adjustment when going from light to dark or vice versa (showing a film, for example).  Be sensitive to declining hearing problems for some learners. Use extra voice or media amplification.

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

## 4. Special coating additives

- a. In addition to additives which make coatings opaque, there are additives used which increase the adhesion strength of the coating and make penetration more difficult.
- b. One typical additive is aluminum oxide particles. These particles are mixed with the coating while it is in a liquid state. When the mixture is cured, it forms a compound so hard and abrasive that it will rapidly dull even diamond-tip instruments.
- (1) This compound is most commonly used by manufacturers to protect trade secrets or to prevent repair.

h09

1185



TABLE 2, con't.

INSTRUCTIONAL ELEMENT	RESEARCHERS	APPLICATION SUGGESTIONS
		<p>Permit and promote self pacing.</p> <p>Promote certainty, confidence, and success by moving from easy material to difficult (build on earlier successes).</p>
Involving the Learner in the Learning Process	<p>Gordon, R.D. (1974)</p> <p>Hiemstra (1975, 1976a)</p> <p>Knox (1977)</p> <p>Mullan &amp; Gorman (1972)</p> <p>Tough (1979)</p> <p>Wass and West (1977)</p>	<p>Facilitate the learner's active involvement in all aspects of the learning process.</p> <p>Facilitate self-directed learning.</p> <p>Encourage self-directed determining of learning goals, learning approaches, and learning resources.</p> <p>Reduce learner dependency on the instructor and increase self-responsibility.</p> <p>Enhance the development of a positive self-concept.</p> <p>Promote self-motivation and learning efficiency.</p> <p>Utilize discovery techniques.</p>
Organization & Meaningfulness in the Learning Material	<p>Craik (1977)</p> <p>Glynn and Muth (1979)</p> <p>Gordon, R.D. (1974)</p> <p>Gounard &amp; Hulicka (1977)</p> <p>Hultsch (1975)</p> <p>Jones (1980)</p> <p>Knox (1977)</p> <p>Lersten (1974)</p>	<p>Be highly organized.</p> <p>Instructional objectives can help to focus and orient.</p> <p>Use prequestions, outlines, study guides, or other forms of advanced organizing techniques.</p> <p>Help learners organize and reorganize their learning.</p> <p>Stress overlearning, differences between concepts, tying together of concepts, and</p>

OUTLINE OF INSTRUCTION

c. Another common additive is powered silica (sand). This additive forms a coating compound even harder than aluminum oxide. Diamond-tip cutting instruments are completely useless.

(1) Module with silica and black colorant added to the potting compound

(2) This type of additive is most commonly used for security purposes on highly classified equipment

INSTRUCTOR ACTIVITY

(1) Display slide YXP L5-559.

STUDENT ACTIVITY

TABLE 2 (Con't.)

INSTRUCTIONAL ELEMENT	RESEARCHERS	APPLICATION SUGGESTIONS
	<p>Hixon (1968) Hulicka and Grossman (1967) Jones (1980) Mullan and Gorman (1972) Okun and Siegler (1977)</p>	<p>Utilize multiple choice testing instead of essay.</p> <p>Minimize the chance of failure the impact of making errors (test-retest, pass-retake, non-grading, etc.)</p> <p>Provide regular feedback on progress.</p> <p>Utilize positive feedback techniques.</p> <p>Use review strategies.</p> <p>Use peer group feedback/evaluation techniques.</p> <p>Reduce or eliminate required homework and graded testing procedures.</p>

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

## C. Microminiature Component Characteristics

## 1. Heat sensitivity

a. Nearly all micro-electronic components are highly susceptible to damage by heat

b. Typical micro-electronic components

c. Inside of IC package

b. Display slide YXP L5-S60.

c. Display slide YXP L5-S61

909

1189

anxiety producing requirements in the learning setting.

### Hesitancy

Hesitancy, cautiousness, and reluctance to risk making errors are discussed by a variety of researchers. Okun (1977) and Okun and DiVesta (1976) suggested that cautiousness tendencies in older learners are direct motivation inhibitors. Lack of risk taking and a concern for accuracy also are thought to be learning obstacles (Botwinick, 1973; Canestrari, 1963, 1968). Jones (1979) noted that learner's attitudes and self-concept perceptions may have as much effect as age on learning abilities.

Obviously, the teacher of older adults needs to utilize those methods or approaches that minimize the possibility of making errors or entering perceived high risk situations. However, Palmore (1970) suggested that the normal aging person tends to find ways of compensating for losses in one area by increases in other areas. Those responsible for guiding the learning of older adults need to find ways of facilitating such compensating abilities.

### Speed and Pacing

Several steps can be taken by the teacher of older adults in relation to speed problems. For example, the time allowed for tests or for responses to queries can be made flexible. Facilitating self-paced learning wherever possible also is important. Finally, speed can be controlled in most instances involving older adults as learners by using appropriate pacing procedures (e.g., see Arenberg and Robertson-Tchabo, 1977; Labouvie-Vief, 1976).

The instructor's role also is important in terms of the speed of presenting information or expectations for their learner's response speed (Witte and Freund, 1976). Most authorities suggest that there is a natural slowing of the learning process that occurs with age; nevertheless, the relationship to cognitive capacity is not completely understood. Slowing is most likely associated with several factors which relate in some way to learning, for example, perceptual deficits, response time, processing time, and remembering time.

If a teacher allows for adequate response time, for example, research suggests that the elderly will perform about as well as younger people (Eisdorfer, 1965). The reverse of adequate time affecting older adult learning can be inferred from such findings. Thus, current and potential teachers of older persons should examine how they pace the learning

### OUTLINE OF INSTRUCTION

- d. If the internal parts of a micro-electronic component are allowed to reach soldering temperatures for even a short period of time, damage will result

(1) Pictorial drawing of IC chip

(2) Micro-photo of an IC chip

### 2. Electrical sensitivity

- a. Except for a very few high power or high voltage devices, all micro-electronic components may be damaged by extremely small electrical potentials

### INSTRUCTOR ACTIVITY

(1) Display slide YXP L5-S62.

(2) Display slide YXP L5-S63.

### STUDENT ACTIVITY

## THE NEED FOR FURTHER RESEARCH

It should be clear that a great deal of general research interest exists in this area. Of less interest is the study of older adults in terms of learning activity, needs, and potential. Nevertheless, interest in these areas appears to be on the increase.

One of the main problems is that much of the research on the learning capacity of older adults has been cross-sectional in nature. That is, we have some understanding of generational and demographic differences but no real comprehension of change over time. The few longitudinal studies conducted to date often demonstrated a dimension of knowledge about learning activity and ability quite different from cross-sectional findings. It seems imperative, therefore, that considerable resources be invested in long-term efforts.

A related situation is the fact that much of what we know even from cross-sectional research comes from the study of just the "old": the retired, those involved with senior programs, and the institutionalized. Thus, middle-aged and younger adults as learners need to be studied in light of their current abilities, preparation for later life learning, and changing need patterns.

Another problem has been the frequently unknown effect of researchers themselves on study results. The types of testing procedures, the definition of the problem in relation to existing theory, and the "halo effect" experienced by subjects all have potential bearing on results. Clearly there is a need for improved methodologies specifically designed for research on the older person.

Perhaps the most positive sign of growth in understanding how to be successful in guiding the older adult learner is the

### OUTLINE OF INSTRUCTION

- b. In addition to powered circuits the potentials may be developed from such things as stray voltages on power soldering tools or static electricity from your fingers.
- c. To avoid damage, constant care must be taken to ensure that no stray voltage potential of any sort is allowed to contact components leads
- d. Particular care must be taken with normal circuit operating potentials since they will almost invariably cause damage if applied to the wrong leads

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

809

1173.

1172



Although these few suggestions are broad in nature, they provide an overall awareness of what lies ahead as we strive to better understand how to guide the older adult learner. Even if the readers do not personally undertake the required research, it is hoped that they will be stimulated to stay abreast of such research, to think critically about the findings, and to challenge those doing research to produce practical and useful knowledge.

Knowledge on how to cope with the learning limitations of older adults is growing at a rapid rate. The unparalleled capacity of the aging person to cope, compensate, and build on the experience of a lifetime of living is a marvel to see. We are only beginning to obtain a glimpse of that potential.

### OUTLINE OF INSTRUCTION

#### 3. Mechanical sensitivity

- a. All micro-electronic components are sensitive to, and easily damaged by, mechanical stresses
- b. The delicate crystalline structure of the IC chip and the glass hermetic seal around leads are both easily damaged by stresses such as dropping the component or cutting the leads with dull cutters
- c. Excessive force of stress, applied when positioning the component or bending leads, is one of the most common causes of damage

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

Turning on all the lights, opening some curtains along a set of north windows, and bringing in the coffee pot from the other room completed my initial preparation.

As the participants drifted in, I introduced myself, got coffee for those who wanted it, and had each person pin on a name tag so I could begin memorizing names. After all had assembled, I began an informal discussion of my background, why I had been asked to help, and some of the potential topics for study. Participants slowly began to join in the discussion; we spent about thirty minutes sharing perceptions of recreation needs they might want to respond to in the future.

I then asked them to work in three small groups of five each for the purpose of further discussing potential study areas, adding new ideas, and prioritizing what we should work on during our sessions together. I provided each group with sheets outlining several possible study areas and asked them to select a moderator or recorder for purposes of sharing their results with the other groups. I "floated" among the groups clarifying points and answering questions.

After about forty-five minutes of discussion, each leader shared the group's results. I recorded them with a large, black magic marker on some white newsprint taped to the walls. We all discussed the three group reports, merged needs or topics of concern together where possible, agreed on an agenda of activity for the next five weeks, and committed ourselves to building a notebook of ideas, resources, and other notes of personal meaning as a supplement for the resources notebook I then provided.

I concluded the session by involving them all in learning some physical fitness and stretching activities that could be used with older persons and suggested some public library material available for them if they were interested.

During that next week I organized the remaining five sessions, secured a film on recreation and leisure for a session, made arrangements for a 4-H folk dance team and a cardio-pulmonary resuscitation team from a local hospital to put on demonstrations during two sessions. (These last two needs had emerged as extra interests during the group discussion.) I also outlined these on a class planning sheet. I then boned up on several of the recreational activities I wanted to demonstrate during the remaining sessions.

The second and third sessions proceeded nicely with the two demonstrations, with my leading the participants in several activities, and with a positive group rapport. The second

#### OUTLINE OF INSTRUCTION

#### 4. Physical size

- a. There are literally thousands of different size-shape combinations used in making microminiature components
- b. During your previous training you have been shown the most common shapes of these components
- c. Their size varies to such great extent that it is not practical to attempt to show all the variations. Size may range from an inch or more to such microscopic dimensions that it is nearly impossible to distinguish the component with the naked eye

#### INSTRUCTOR ACTIVITY

#### STUDENT ACTIVITY

019

1177

## Serving as a Conference Resource Person

The author frequently is asked to serve as a resource person for a conference or workshop. Although not specifically related to the older learner, this anecdotal note about an in-service training activity will illustrate some concepts related to this paper.

Last year I was asked to serve as resource leader for a session on program planning during an in-service training program at a community college. Initially, they wanted me to run two, back-to-back, one-hour sessions for rotating groups. I negotiated a two-hour session for a single group. I also asked for a room large enough to seat all the participants in a circle (sixty-four attended), a chalk board, a newsprint pad and stand, adequate sound amplification, and an overhead projector with a screen.

I developed a sheet outlining possible topics for discussion and study based on my perceptions of what the probable participants did as well as feedback from a phone conversation with a former student who now worked as a teacher in a community college. I also put together sets of transparencies on various topics related to program planning, developed several summary handouts on what I felt were crucial areas, and put together an annotated bibliography on various books, journals, and other material on program planning.

To begin the session, I had the participants introduce themselves and briefly describe their positions. I then described what I believed to be some skills crucial for effective program planning. I handed out the sheet of potential topics and asked them to pull their chairs into new circles of about ten people each. They were asked to discuss the topics in light of their most important needs and to be prepared for sharing the group's three most important needs in a report back to the larger group. This required negotiation and prioritizing.

During the group reports I summarized on newsprint the prioritized topics, merging or seeking clarity where appropriate, and, finally, obtaining consent to present information on six topics. Approximately fifty minutes were required for these activities.

As participants took a ten minute coffee break, I quickly pulled out of my box of resource materials, the various sets of transparencies, and notes relating to the prioritized topics. During the second hour I introduced concepts using the transparencies as stimulators; I also summarized points made during the questioning and sharing. Since the third topic was

OUTLINE OF INSTRUCTION

- d. UNIVAC Module with through-board mounting
- e. Component side of UNIVAC module
- f. Close view of UNIVAC module components
- g. Close view of UNIVAC module circuitry
- h. Expanded view of pad areas.

INSTRUCTOR ACTIVITY

- d. Display slide YXP L5-567.
- e. Display slide YXP L5-568.
- f. Display slide YXP L5-569.
- g. Display slide YXP L5-570.
- h. Display slide YXP L5-571.

STUDENT ACTIVITY

The same day I interviewed him, I noticed another person slumping in an outer reception room chair. He was in a fairly disheveled state, clothing awry, and not noticing anything around him. I asked a nurse about his condition and she said he was having senility problems but enjoyed sitting in the lobby to watch the people go by.

I approached him, got his attention, and eventually started a conversation. After some difficult starts, I got him talking about himself. It turned out he was seventy-six years old, his wife had been dead for five years, and his children were all living on the West Coast. He, too, had been an agricultural specialist until his retirement ten years prior. We talked about his experiences, his grandchildren, and his views on today's agriculture. During the hour long conversation he transformed before my eyes into the image of my other interviewee. He slowly straightened up in his chair, became animated, straightened up his clothing, and ran his hand through his hair. He smiled, he talked wisely, he wished for the future, he became alive!

Two hours later I passed by again on my way home. An untouched tray of food was lying on a table next to him, he was slumped down in his chair, glassy eyed, his clothing again crumpled. It was a long time before I could think about much of anything else.

Maudlin? Perhaps! But what is that almost mysterious quality called "human potential"? What is our role as educators in enhancing that potential? What should we be doing that we are not?

#### Eldercollege

A year ago the Iowa State University Alumni Foundation funded a project called Eldercollege. The goal of the project was to provide college-level education to older persons. The following is an outline of the sequential activities in that project. It is included in order to give the reader a sense of how the staff attempted to employ what we could from the literature and theory on providing educational opportunities to older adults.

#### 1. Proposal conceptualized - 3 months, May to July

- Ideas discussed with colleagues

- Literature reviewed

- Trip to Kentucky and Washington, D.C. to review similar programs and to seek advice

- Draft of proposal written

OUTLINE OF INSTRUCTION

D. Solder-Joint Construction

1. Through-board joints

- a. Miniaturized through board circuitry
- b. Miniaturized circuitry with design defect
- c. Through-board mounting on MLPCB

INSTRUCTOR ACTIVITY

- 1. Describe some of the styles of connections the student's wouldn't be familiar with. Point out the damage on each board.

- a. Display slide YXP L5-S64.
- b. Display slide YXP L5-S65.
- c. Display slide YXP L5-S66.

STUDENT ACTIVITY

612

1181

1180



(institutional, philosophical, pre-retirement counseling  
office, and available resources)  
Initial report of need developed  
Staff, chief administrators, and outside evaluator react to  
report  
Progress report provided to funding source  
Final report developed

6. Program planning and prototype development - 1 month, March

Two highest ranked needs selected  
Objectives for a program developed (measurable)  
Advisory council reacts  
Initial program outlined (two courses)  
Staff evaluates initial plans, checks Gantt chart, and makes  
appropriate modifications  
Instructional staff identified (ten different instructors)  
Training materials on how to teach older people developed  
Instructors trained  
Support material needed for the courses identified  
Library and media resources obtained  
Parking permits for students arranged  
Coffee and snacking arrangements made  
Necessary fees for course established and payment arrangements  
made  
Publicity outlined and developed including brochures for  
mailing, newspaper advertising, and literature for offices  
dealing with older people  
Evaluation techniques and procedures developed including a  
progress assessment completed by the outside evaluator  
Registration procedures developed  
Accounting procedures developed  
Room arrangements finalized

7. Assessment of commitment to proceed - 1 month, March

One course did not have enough students to warrant it  
beginning  
Students all agreed to enter the other course  
Staff determined that time of day (any evening) just would  
not fill with elderly even though initial needs information  
showed that they would

8. Program (course) initiated - 2 months, April and May

Students enrolled  
Course monitored

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
2. Surface joints		
a. Surface type solder joints are commonly called lap joints		
b. In this type of joint the component lead is placed or lapped on top of the solder pad area and soldered into place		
c. All connection and bonding in the surface or lap joint is formed by the solder itself. For this reason the quality and strength of the solder connection in this type of joint is exceptionally critical		

## APPENDIX B

### RESOURCES

#### Periodicals

In addition to a number of significant books cited in this paper, numerous journals include articles related to learning and the older person. Some of the major ones are as follows:

Adult Education. Published quarterly by the Adult Education Association of the U.S.A. A research-oriented journal that frequently contains reports of studies or theoretical pieces related to education of the elderly.

Adult Education  
Studies in Adult Education  
101 Gabel Hall  
Northern Illinois University  
De Kalb, Illinois 60115

Aging. Published bi-monthly by the federal Administration on Aging. This journal, the official publication of the U.S. Administration on Aging, reports on programs for, by, and with the elderly.

Aging  
Superintendent of Documents  
Government Printing Office  
Washington, D.C. 20402

Educational Gerontology: An International Quarterly. Published quarterly by Hemisphere Publishing. A combination practitioner and research journal that includes a wide variety of information

OUTLINE OF INSTRUCTION

- d. Surface joints are a very common mounting style for ICs and other micro-electronic components
- e. Module with lap-soldered ICs
- f. Rear view of module with lap-soldered ICs
- g. Closeup of lap-soldered ICs
- h. Module with lap-soldered ICs
- i. CPC with lap-soldered component

INSTRUCTOR ACTIVITY

- e. Display slide YXP L5-S72.
- f. Display slide YXP L5-S73.
- g. Display slide YXP L5-S74.
- h. Display slides YXP L5-S75 and YXP L5-S76.
- i. Display slide YXP L5-S77.

STUDENT ACTIVITY

h19

110

Modern Maturity. Published bi-monthly by the American Association of Retired People. This periodical occasionally contains articles related to the teaching of elderly or to the elderly as teachers.

Modern Maturity  
American Association of Retired People  
1909 K Street, N.W.  
Washington, D.C. 20049

#### Professional Associations

In addition to state and regional associations, three of the major national groups are as follows:

Adult Education Association of the U.S.A. (AEA). This association sponsors an annual conference, publishes Adult Education and Lifelong Learning: The Adult Years, and makes available to members and others a wide variety of publications related to the adult education field. One of the central subgroups within the association is the Commission on Education for Aging that puts on meetings and publishes a newsletter. The association also has a Washington office and serves as a voice for the adult education field.

Adult Education Association of  
the U.S.A.  
810 Eighteenth Street, N.W.  
Washington, D.C. 20006

Association for Gerontology in Higher Education (AGHE). This association sponsors an annual meeting, publishes a newsletter and other materials, and serves as a voice for educational gerontology professionals in higher education through its Washington office.

Association for Gerontology in  
Higher Education  
One Dupont Circle  
Suite 520  
Washington, D.C. 20036

Gerontological Society. This association publishes The Gerontologist and the Journal of Gerontology and a variety of other materials. It also sponsors an annual conference, has a Washington office, and serves as a voice for a wide variety of gerontology professionals.

Gerontological Society  
One Dupont Circle  
Suite 520  
Washington, D.C. 20036

OUTLINE OF INSTRUCTION

3. Solder cups

- a. PCB solder cups in use - hollow standoff similar to a connector pin
- b. The purpose of the solder cup is to act as a connection point for several component leads when vertical component mounting is used
- c. Solder cups are not microminiature, but they are normally found on a module whose packaging density requires microminiature tools or techniques for repair

INSTRUCTOR ACTIVITY

- c. Display slide YXP L5-S78.

STUDENT ACTIVITY

1187

5/9

1186

4-2-43

## REFERENCES

- Agruso, V.M., Jr. Learning in the Later Years. New York, New York: Academic Press, 1978.
- Aiello, D.R. and Rogers, C.J. The Effects of Presentation Variables Upon Clustering and Recall Performance in the Elderly. Paper presented at the annual meeting of the Southwestern Psychological Association, Albuquerque, New Mexico, 1976. (ED 149 119)
- Aiken, L. Later Life. Philadelphia, Pennsylvania: W.B. Saunders Company, 1978.
- Alpaugh, P.D. et al. "Age and Creativity: Implications for Education and Teachers." Educational Gerontology. 1(January-March, 1976): 17-40.
- Arenberg, D. Changes With Age in Learning and Memory. Paper presented at the annual convention of the American Psychological Association, Washington, D.C., 1976. (ED 137 665)
- \_\_\_\_\_. "The Effects of Auditory Augmentation on Visual Retention on Young and Old Subjects." Journal of Gerontology. 32(1977): 192-195.
- \_\_\_\_\_. and Robertson, E.A. "The Older Individual as a Learner." Learning for Aging. Edited by S. Grabowski and W.D. Mason. Washington, D.C.: Adult Education Association of the USA, n.d.
- \_\_\_\_\_. and Robertson-Tchabo, E.A. "Learning and Aging." Handbook of the Psychology of Aging. Edited by J.E. Birren and K.W. Schaie. New York, New York: Van Nostrand and Reinhold, 1977.
- Ausubel, D.P. The Psychology of Meaningful Verbal Learning. New York, New York: Grune and Stratton, 1963.
- Baltes, M.M. and Barton, E.M. "New Approaches Toward Aging: A Case for the Operant Model." Educational Gerontology. 2(October-December, 1977): 382-405.

OUTLINE OF INSTRUCTION

4. Welded leads

a. Welded leads are a fairly common occurrence as a mounting style for micro-electronic components.

b. Welds will be either parallel gap or points contact style

INSTRUCTOR ACTIVITY

4. Project and briefly point out the various characteristics of slides YXP L5-S79 through YXP L5-S84.

STUDENT ACTIVITY

9/9

189



- Botwinick, J. Aging and Behavior (Second edition). New York, New York: Springer, 1978.
- Butler, R. Why Survive? Being Old in America. New York, New York: Harper and Row, 1975.
- Calhoun, R.D. and Gounard, B.R. "Meaningfulness, Presentation Rate, List Length, and Age in Elderly Adults' Paired-Associate Learning." Educational Gerontology. 4(January-March, 1979): 49-56. (EJ 193 772)
- Canestrari, R.E., Jr. "Paced and Self-Paced Learning in Young and Elderly Adults." Journal of Gerontology. 18(1963): 165-168.
- \_\_\_\_\_. "Age Changes in Acquisition." Human Aging and Behavior. Edited by G.A. Talland. New York, New York: Academic Press, 1968.
- Carpenter, W.L. The Relationship Between Age and Information Processing Capacity and Age and Channel Capacity of Adults. Ph.D. Dissertation, Tallahassee: Florida State University, 1967.
- Catino, C. et al. "Mediation in Children and the Elderly as a Function of Memory Capabilities." Journal of Genetic Psychology. 130(March, 1977): 35-47.
- Cattell, R.B. The Scientific Analysis of Personality. Baltimore, Maryland: Penguin, 1965.
- Craik, F.I.M. "Age Differences in Human Memory." Handbook of the Psychology of Aging. Edited by J.E. Birren and K.W. Schaie. New York, New York: Van Nostrand and Reinhold, 1977.
- \_\_\_\_\_. and Masini, P.I. "Age Differences in the Temporal Integration of Language." British Journal of Psychology: General. 104(1975): 268-294.
- Cross, K.P. Accent on Learning. San Francisco, California: Jossey-Bass, Publishers, 1977.
- \_\_\_\_\_.; Valley, J.R.; and Associates. Planning Non-Traditional Programs. San Francisco, California: Jossey-Bass, Publishers, 1975.
- Cumming, E.M. "Further Thoughts on the Theory of Disengagement." International Social Science Journal. 15(1963): 377-393.

### OUTLINE OF INSTRUCTION

- (1) The most common weld currently in use is the parallel gap style. It is generally used when only one of the conductors to be joined is free to move. This style is readily identifiable as it leaves a thin black line across the welded lead. A parallel gap weld is formed by bringing two parallel tips into contact with one of the leads to be joined and passing a high current pulse between the tips
  
- (2) Point contact welding is an older style and is generally used where both conductors to be joined are free to move. The point contact weld is formed by bringing two tips together so that the conductors to be joined are pressed between them and passing a high current pulse between the tips. Only very careful inspection will show that this type of joint is welded rather than soldered

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY



617

1191

- Gordon, R.D. Learning Process in Aging and Adult Education. 1975. (ED 106 734)
- Gordon, S.K. Adult Age Differences in Storage and Retrieval Processes in the Retention of Related Sentences. Paper presented at the annual meeting of the American Psychological Association, New Orleans, Louisiana, 1974. (ED 099 752)
- Goulet, L.R. General and Specific Interference Factors in Retention. Paper presented at the American Psychological Association Convention, Miami Beach, Florida, 1970. (ED 044 710)
- Gounard, B.R. and Hulicka, I.M. A Cognitive Problem-Solving Approach to Learning in Later Adulthood. Paper presented at the annual meeting of the American Educational Research Association, New York, 1977. (ED 154 965)  
Printed as "Maximizing Learning Efficiency in Later Adulthood: A Cognitive Problem-Solving Approach." Educational Gerontology. 2(October-December, 1977): 417-427. (EJ 169 291)
- Graney, M.J. and Hays, W.C. "Senior Students: Higher Education After Age 62." Educational Gerontology. 1(October-December, 1976): 343-360.
- Gross, R. The Lifelong Learner. New York, New York: Simon and Schuster, 1977.
- Grotelueschen, A.D. Influence of Cognitive and Affective Factors on Adult Learning: Three Experimental Studies. Final Report. Urbana: University of Illinois, Center for Instructional Research and Curriculum Evaluation, 1972. (ED 092 800)
- Haase, A.M.B. et al. "Teaching the Aged Reader: Issues and Strategies." Educational Gerontology. 4(July-September, 1979): 229-237.
- Havighurst, R.J. "Education Through the Adult Life Span." Educational Gerontology. 1(January-March, 1976): 41-51. (EJ 134 251)
- Hiemstra, R. "Continuing Education for the Aged: A Survey of Needs and Interests of Older People." Adult Education. 22(1972): 100-109.
- \_\_\_\_\_. The Older Adult and Learning. Occasional Paper no. 1. Ames, Iowa: Adult and Extension Education, Iowa State University, 1975.

OUTLINE OF INSTRUCTION

E. Evaluating Repair Tasks and Procedural Steps

1. Workpiece analysis

- a. You have been taught in previous training that before taking any action towards the repair of a workpiece, both the workpiece and the job to be done must be thoroughly analyzed and a complete plan of action decided upon
- b. At this point in the course, you have been taught the information needed to enable you to make a complete analysis of micro-electronic workpiece

INSTRUCTOR ACTIVITY

E. Display slide YXP L5-S90.

STUDENT ACTIVITY

819

1193

- Hultsch, D.F. "Adult Age Difference in Free Classification and Free Recall." Developmental Psychology. 4(1971): 338-342.
- \_\_\_\_\_. "Adult Age Differences in Retrieval: Trace-Dependent and Cue-Dependent Forgetting." Developmental Psychology. 11(1975): 197-201.
- \_\_\_\_\_. "Changing Perspectives on Basic Research in Adult Learning and Memory." Educational Gerontology. 2(October-December, 1977): 367-382. (EJ 169 288)
- Jackson, D.W. "Relationship of Residence, Education, and Socialization to Cognitive Tasks in Normal People of Advanced Old Age." Psychological Reports. 35(August, 1974): 423-426. (EJ 110 041)
- Jarvik, L.F. "Thoughts on the Psychology of Aging." American Psychologist. 30(1975): 576-583.
- Jones, E.E. "Adult Education and the Older Adult." Educational Gerontology. 4(October-December, 1979): 349-354.
- Jones, H.E. and Conrad, H.S. "The Growth and Decline of Intelligence." Genetic Psychology Monographs. 15(1933), 233-298.
- Jones, J.E. "Teaching Art to the Elderly: Research and Practice." Educational Gerontology. 5(January-March, 1980): 17-31
- Kasworm, C.E. "Old Dogs, Children, and Watermelon Wine." Educational Horizons. 56(Summer, 1978): 200-205. (EJ 129 860)
- Kausler, D.H. and Kleim, D.M. "Age Differences in Processing Relevant Versus Irrelevant Stimuli in Multiple-Item Recognition Learning." Journal of Gerontology. 33(1978): 87-93.
- Keitz, S.M. and Gounard, B.R. "Age Differences in Adults' Free Recall of Pictorial and Work Stimuli." Educational Gerontology. 1(1976): 237-241. (EJ 144 262)
- Kidd, J.R. "Adult Learning in the 1970's." Adult Learning: Issues and Innovations. Edited by R.M. Smith. DeKalb: ERIC Clearinghouse in Career Education, Northern Illinois University, 1976. (ED 131 197)
- Knowles, M.S. The Modern Practice of Adult Education. New York, New York: Association Press, 1970.

### OUTLINE OF INSTRUCTION

- c. When making an analysis of each workpiece, you are performing the most important part of insuring that no additional damage or degradation is incurred on the workpiece as a result of your repair actions

### 2. Damage evaluation

- a. The next step of your preparation for repair is to locate all damage or failures on the workpiece, and determine their extent
- b. The nature of all damage and the area affected must be determined before you can effectively outline the repairs to be performed

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

- Marcus, E.E. Factors Affecting the Self-Image of the Older-Aged Learner. 1972. (ED 070 957)
- \_\_\_\_\_. Effect of Age on Perception of the Utility of Participation in Education. Paper presented at the annual meeting of the Gerontological Society, New York, New York, 1976. (ED 141 691)
- \_\_\_\_\_. "Effects of Age, Sex, and Status on Perception of the Utility of Educational Participation." Educational Gerontology. 3(October-December, 1978): 295-319.
- McClusky, H.V. "The Relevance of Psychology for Adult Education." Adult Education: Outlines of an Emerging Field of University Study. Edited by G. Jensen et al. Washington, D.C.: Adult Education Association of the USA, 1964.
- \_\_\_\_\_. "The Adult as Learner." Management of the Urban Crisis. Edited by S.E. Seashore and R.J. McNeill. New York, New York: Macmillan Company, 1971.
- \_\_\_\_\_. "Education and Aging." A Manual on Planning Education Programs for Older Adults. Edited by A. Hendrickson. Tallahassee: Department of Adult Education, Florida State University, 1973.
- \_\_\_\_\_. "Education for Aging: The Scope of the Field and Perspectives for the Future." Education for the Aging. Edited by S.M. Grabowski and W.D. Mason. Syracuse, New York: ERIC Clearinghouse on Adult Education, 1974.
- McMahon, A.T. "Needs for New Emphasis in Social and Educational Policy Toward the Elderly." Educational Gerontology. 4(April-June, 1979): 101-113.
- Merriam, S. "Interviewing the Aged: Some Considerations for the Adult Educator." Adult Leadership. 25(March, 1977): 215-216. (EJ 161 789)
- Meyer, S.L. "Andragogy and the Aging Adult Learner." Educational Gerontology. 2(April-June, 1977): 115-122.
- Monge, R.H. and Hultsch, D. "Paired-Associate Learning As A Function of Adult Age and the Length of the Anticipation and Inspection Intervals." Journal of Gerontology. 26(1971): 157-162.
- Moody, H.R. "Philosophical Presuppositions of Education for Old Age." Educational Gerontology. 1(January-March, 1976): 1-16.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

3. Task determination

- a. When the workpiece has been completely analyzed and all damage evaluated, you will have the information needed to decide what repairs must actually be performed on the workpiece
- b. In determining the repair task (or tasks) remember that all steps taken in disassembly, repair, and reassembly are a part of the overall repair task

4. Procedural outline - the final step in preparation for repair is to combine the information gained from analyzing the workpiece, the damage, and the repair task into a single comprehensive step-by-step repair procedure

620

1197



- Raymond, B. J. "Free Recall Among The Aged." Psychological Reports. 29(December, 1971): 1179-1182. (EJ 053 155)
- Robertson-Tchabo, E.A. et al. "A Classical Mnemonic for Older Learners: A Trip That Works!" Educational Gerontology. 1(July-September, 1976): 215-226. (EJ 144 260)
- Schaie, K.W. "Toward A State Theory of Adult Cognitive Development." Journal of Aging and Human Development. 8(1977-78): 129-138.
- \_\_\_\_\_ and Strother, C.R. "A Cross-Sectional Study of Age Changes in Cognitive Behavior." Psychological Bulletin. 70(1968): 671-680.
- \_\_\_\_\_ and Strother, F. Human Aging and Behavior. New York, New York: Academic Press, 1968.
- Schonfield, A.E. et al. "Recognition Tests of Dichotic Listening and Age Variable." Journal of Gerontology. 27(1972): 487-493.
- Sheppard, N.A. Educational Opportunities for Older Persons: A Review. IN Series 170. Columbus, Ohio: ERIC Clearinghouse on Adult, Career, and Vocational Education, 1979. (ED 181 792)
- Simon, J.R. and Pouraghabaghew, A.R. "The Effect of Aging on the Stages of Processing in a Choice Reaction Time Task." Journal of Gerontology. 33(1978): 553-561. (EJ 182 983)
- Symposium on Adult Learning Psychology: Implications for Higher Education. Buffalo: State University of New York at Buffalo, Division of Continuing Education, 1973. (ED 094 173)
- Taub, H.A. "Free and Ordered Recall: Coding as a Function of Age." Journal of Genetic Psychology. 131(September, 1977): 75-81. (EJ 170 314)
- Terman, L.M. and Oden, M.H. The Gifted Group of Mid-Life. Stanford, California: Stanford University Press, 1959.
- Thorndike, E.L. Adult Learning. New York, New York: Macmillan Company, 1928.
- Tough, A.M. "Major Learning Efforts: Recent Research and Future Directions." Adult Education. 28(Summer, 1978): 250-263.
- \_\_\_\_\_. The Adult's Learning Projects. Austin, Texas: Learning Concepts, 1979.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

III. APPLICATION - NONE

IV. SUMMARY

A. Introduction

A. Emphasize importance of the summary for the student.

1. Nature of summary.

2. Purpose of summary.

B. Directions to Students

1. Questions

1198

1199

621

Woodruff, D.S. and Walsh, D. "Research in Adult Learning:  
The Individual." The Gerontologist. 15(1975); 424-430.  
(EJ 125 578)

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>2. Notes</p> <p>C. Recap of Lesson</p> <p>1. Circuit board construction</p> <p>2. Conformal coating compounds</p> <p>3. Microminiature components characteristics</p> <p>4. Solder-joint construction</p>	<p>C. Emphasize Safety</p>	<p>C. Ask questions if material not clear; check notes to insure accuracy and completeness.</p>

622

1201

9412P1 1200

4-2-50

- Gentile, L.M. and McMillan, M. "Reading: A Means of Renewal for the Aged." Educational Gerontology. 4(July-September, 1979): 215-223.
- Gordon, S.K. and Slevin, A.E. Imagery and Sentence Retention in Elderly and Young Adults. Paper presented at the Meeting of the Gerontological Society, Louisville, Kentucky, October, 1975.
- Grabowski, S. and Mason, W.D. Learning for Aging. Washington, D.C.: Adult Education Association of the U.S.A., n.d. (ED 099 541)
- Griffith, W. and McClusky, H.Y., eds. Handbook Series in Adult Education. San Francisco, California, 1980.
- Howell, S.C. "Familiarity and Complexity in Perceptual Recognition." Journal of Gerontology. 22(1967): 180-184.
- Jenkins, J.J. "Remember That Old Theory of Memory? Well, Forget It!" American Psychologist, 29(1974): 785-795.
- Kline, D.W. and Sabran, J. "Age Differences in Backward Monoptic Visual Noise Masking." Journal of Gerontology. 30(1975): 307.
- Knox, A.B. ed. New Directions for Continuing Education. A Quarterly Sourcebook. San Francisco, California: Jossey-Bass, Inc., 1979.
- Labouvie-Vief, G. and Gonda, J.N. Cognitive Strategy Training and Intellectual Performance in the Elderly. Paper presented at the Annual Meeting of the American Psychological Association, Chicago, Illinois, 1975.
- Laurence, M.W. "Memory Loss With Age: A Test of Two Hypotheses." Psychonomic Science. 9(1967): 209-210.
- Long, H.B. et al. Changing Approaches to Studying Adult Education. San Francisco, California: Jossey-Bass, 1980.
- McClusky, H.Y. Effective Leadership. Speech at the Chautauqua Institution 55-Plus Program, Chatauqua, New York, 1977.
- \_\_\_\_\_. Toward a National Policy on Aging. Final Report, Volume II and Sourcebook on Education. 1971 White House Conference on Aging. Washington, D.C.: Government Printing Office, 1973.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>5. Evaluating repair talks and procedural steps</p>		
<p>V. <u>INFORMAL TEST</u></p> <p>There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application."</p>		
<p>VI. <u>ASSIGNMENT</u></p> <p>Read and study 4-2-1N</p>	<p>Provide students with the home-work assignment.</p>	<p>Ask questions if the assignment is unclear. Complete assignment.</p>

Wilkie, F.L. and Eisdorfer, C. "Sex, Verbal Ability and Pacing Differences in Serial Learning." Journal of Gerontology. 32(1977): 63-67. (EJ 150 031)

Woodruff, D.S. and Birren, J.E. "Biofeedback Conditioning of the EEG Alpha Rhythm in Young and Old Subjects." Proceedings of the 80th Annual Meeting of the American Psychological Association. 7(1972): 673-674.

FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M)  
Program A-1DD-0034

Lesson Topic 4.3:  
Micro-Electronic Circuit Conformal Coating  
Removal and Desoldering Techniques

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 2.0 Hours  
Laboratory - 8.75 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides

(1) YXP L9-S1 through YXP L6-S54

3. Training Aids Equipment

- a. Projector, Slide  
b. Screen, Projection, Standard

4. Text

- a. Student's Guide

5. References

- a. PACE Rework and Repair Technology Series,  
Volume 6  
b. MIL-STD-454

TERMINAL OBJECTIVES:

Supported Partially by this lesson topic:

- 7.0 REMOVE conformal coatings from micro-electronic  
printed circuit boards using the proper tools  
and techniques following the procedures and to  
the standards outlined in Volume 6 of the PACE  
Rework and Repair Technology Series.  
8.0 REMOVE micro-electronic printed circuit board  
component parts using the correct tools and  
desoldering techniques following the procedures  
and to the standards outlined in Volume 6 of  
the PACE Rework and Repair Technology Series.

ENABLING OBJECTIVES:

When you complete this lesson topic, you will be able  
to:

- 4.4.1 EVALUATE the repair task to be performed and  
DETERMINE the proper conformal coating  
removal method to be used on micro-electronic  
printed circuit boards. Evaluation and  
determination will be based on information  
contained in Volume 6 of the PACE Series.



4.3.2. REMOVE various conformal coatings from microelectronic printed circuit boards using the chemical, heat and abrasive methods and the proper tools as outlined in Volume 6 of the PACE Rework and Repair Technology Series.

4.3.3. DETERMINE the proper desoldering and component removal method to be used on selected microelectronic circuits utilizing information contained in Volume 6 of the PACE Series.

4.3.4. DESOLDER various types of micro-electronic printed circuit solder connections using the wicking and motorized vacuum extraction methods of desoldering and the proper tools as outlined in Volume 6 of the PACE Series.

#### CRITERION TEST

Satisfactory completion of the Enabling Objectives require the student to remove the conformal coating and desolder predetermined micro components on a minimum of three selected double and/or single sided micro-electronic printed circuit boards. Procedures utilized will be in agreement with the information outlined in the PACE Rework and Repair Series, with minimum degradation to the printed circuit boards.

#### HOMEWORK

Read and study Notetaking Sheet.4-3-IN.

1206



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Accomplishment of daily tasks aboard ship.

2. The necessity of the skills and techniques in repair of printed circuit boards.

3. Personal applications of the knowledge and skills.

4. Seek to motivate. Tell a good tie-in story if possible.

C. Effect

C. When following a subject matter lesson topic, do the following:

629

12 10

OUTLINE OF INSTRUCTION

0. Overview

INSTRUCTOR ACTIVITY

1. Explain relationship of this lesson to previous lesson(s).
2. Commend students for mastery of skills in previous lesson(s).

0. Overview lesson by:

1. Stating learning objectives as contained on cover page to this topic.
2. Stating procedures to be followed during the lesson.

STUDENT ACTIVITY

628

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

629

a. Taking notes.

b. Asking questions.

c. Use of criterion test.

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives or procedures if in doubt.

II. PRESENTATION

A. Conformal coating removal techniques

A. Display YYP L6-S1

A. Ask questions and take notes when necessary.

1211

1213

9459-60P9

4-3-6

OUTLINE OF INSTRUCTION

1. Heat removal

a. Careful application of controlled heat can be used to remove many conformal coatings, this is also true in microelectronic repair.

b. A typical micro-electronic module with an epoxy coating on both sides.

(1) Heat removal methods and tools used on standard modules is not practical for removing coating from micro-electronic modules, due to the size and spacing of components.

INSTRUCTOR ACTIVITY

b. Display Slide YXP L6-S2.

STUDENT ACTIVITY

630

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

(2) Apply controlled heat using improved tools and techniques applicable to micro-electronic circuitry.

2. Abrasion removal - Mechanical abrasion is another useful method of removing coatings. Suitable for micro-electronic circuits on single and double sided boards.

3. Chemical removal

a. The use of solvents to remove coatings is very limited since most solvents, which are strong enough to dissolve coatings, also tend to attack some components.

631

1217

1218

- | OUTLINE OF INSTRUCTION   | INSTRUCTOR ACTIVITY                                       | STUDENT ACTIVITY |
|--|---|------------------|
| b. <u>Always use only the solvents and procedures for coating removal which are recommended in the manufacturer specification.</u> | b. STRESS this fact and any safety precautions necessary. |                  |
| B. Use and capabilities of coating removal tools.  | B. Display Slide YXP L6-S3.                               |                  |
| 1. Hot air jet.  |   |                  |
| a. The hot air jet technique is one of the most versatile coating removal methods.   | a. Display Slide YXP L6-S4.                               |                  |
| b. The hot air jet technique uses the solder extractor in conjunction with low air <u>pressure</u> .                               |   |                  |



OUTLINE OF INSTRUCTION

c. The equipment is set up for this technique as follows:

(1) Adjust the voltage control for the extractor plug to obtain the desired temperature.

(2) Connect the extractor air line to the pressure output and turn the pressure control to MINIMUM.

(3) DEPRESS the footswitch. This will cause air to flow from the extractor tip at the temperature of the heating element.

INSTRUCTOR ACTIVITY

(3) STRESS:  
CAUTION - At maximum voltage the air temperature is approximately 1000 degrees F. and can cause great damage to the workpiece if improperly used.

STUDENT ACTIVITY

633

1222

1221

### OUTLINE OF INSTRUCTION

d. To remove coating with the hot air jet, proceed as follows:

- (1) Blow hot air to the removal area with the extractor tip approximately 1/2 inch away from the surface.
- (2) Use extreme care not to cause workpiece damage.
- (3) Using an orangewood stick or similar tool, push the coating away as it softens and overcures from the hot air.

### INSTRUCTOR ACTIVITY

- (1) Display Slide YXP L6-S5.
- (2) Stress this point.
- (3) Display Slide YXP L6-S6.

### STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

- e. Using the hot air jet and a fine pointed tool, coating can be removed from even the most minute areas.

### 2. Thermal parting

- a. Another very versatile heat removal tool is the thermal parting unit.
- b. Prepare the equipment for thermal parting, as follows:
  - (1) Connect the thermal parting tool to the low voltage AC output on the HS-20.

### INSTRUCTOR ACTIVITY

- a. Display Slide YXP L6-S7.

- (1) Display Slide YXP L6-S8.

### STUDENT ACTIVITY

635

226

1025

OUTLINE OF INSTRUCTION

(2) Depress the footswitch.

(3) Adjust the output control until the parting tip is at a temperature just below the melting point of solder.

(4) The temperature may now be adjusted slightly up or down to obtain best results with the particular coating being removed.

c. Remove coatings with the thermal parting tool, as follows:

1227

INSTRUCTOR ACTIVITY

(4) STRESS:  
NOTE: ALWAYS begin the adjustment procedure with the output control set at ZERO to avoid damaging the parting tool.

STUDENT ACTIVITY

1228

636

### OUTLINE OF INSTRUCTION

- (1) Remove coating from around the component body by over-curing and pushing the coating aside with the hot parting tip. The tip is not hot enough to cause scorching or discoloration.
- (2) Carefully remove coating around leads, being very careful not to touch the board surface. The coating need only be removed down to the widest point of the component body.
- (3) If removing a failed component, the leads may be cut, when removing a KNOWN defective part, since it is the method which normally provided the lowest risk of workpiece damage.

### INSTRUCTOR ACTIVITY

- (1) Display Slide YXP L6-S9.
- (2) Display Slide YXP L6-S10.
- (3) Display Slide YXP L6-S11.  
Stress destructive removal for failed component.

### STUDENT ACTIVITY

637

1230

1229

OUTLINE OF INSTRUCTION

- (4) When the component leads have been cut, the component body should be heated, causing the remaining coating to soften and permit easy component removal.

(a) One method of heating the component body is to use the thermal parting tool.

(b) A temperature controlled soldering iron or the hot air jet is also a reliable method of heating the component body.

INSTRUCTOR ACTIVITY

- (4) Display Slide YXP L6-S12.

STUDENT ACTIVITY

1231

1232

638

4-3-15

## DOCUMENT RESUME

ED 193 530

CE 027 093

AUTHOR Stanley, Elizabeth  
TITLE Credit for Prior or Experiential Learning.  
Information Series No. 210.  
INSTITUTION ERIC Clearinghouse on Adult, Career, and Vocational  
Education, Columbus, Ohio.: Ohio State Univ.,  
Columbus. National Center for Research in Vocational  
Education.  
SPONS AGENCY National Inst. of Education (DHEW), Washington,  
D.C.  
PUB DATE 80  
CONTRACT 400-76-0122  
NOTE 68p.  
AVAILABLE FROM National Center Publications, The National Center for  
Research in Vocational Education, The Ohio State  
University, 1960 Kenny Rd., Columbus, OH 43210  
(\$4.50).

EDRS PRICE MF01/PC03 Plus Postage.  
DESCRIPTORS \*Adult Students; \*College Credits; Credit Courses;  
Degree Requirements; \*Equivalency Tests;  
\*Experiential Learning; Faculty Development;  
\*Nontraditional Education; Postsecondary Education;  
\*Prior Learning; Program Evaluation; Self Evaluation  
(Individuals)  
IDENTIFIERS Canada; Information Analysis; United States

## ABSTRACT

This paper focuses on the activities of colleges and universities providing options for the assessment of prior learning for adult students. The paper emphasizes programs with associate and baccalaureate degree-granting institutions in the United States and Canada. It is aimed at faculty members, practitioners, administrators, and policy-makers, as well as agency or legislative personnel interested in this growing aspect of postsecondary education. An attempt is made to provide sufficient detail to answer questions most often asked by these audiences concerning the adoption of a policy on credit for prior learning and to suggest appropriate resources for further study. The practice of awarding credit for prior learning is traced in the first section. In the second, various approaches to assessing prior learning are surveyed; included in this section is information about credit by examination, credit recommendations for noncollegiate courses, individualized assessment (study orientation, portfolio preparation, measurement and evaluation of learning outcomes, transcription or recording of credit awarded, and other institutional policies), evaluators and faculty development, special interest areas, and costs and fees. The third section discusses quality assurance and program evaluation. The last section examines future directions and implications. Information about credit-for-prior-learning publications is included in the appendixes. (CT)

### OUTLINE OF INSTRUCTION

- (5) Once the component body has been thoroughly heated to weaken the coating bond, it may be removed by gripping it with a pair of pliers and applying a gentle twisting or rocking force. NEVER use a pulling or lifting force as it could result in lead or conductor damage.
- (6) When the defective component has been removed, the surface area of the board should be smoothed and cleaned to accept the replacement part. The smoothing may be done with the thermal parting tool or by using abrasive grinding methods.
- (7) If non-destructive component removal is necessary, the same basic procedure is followed using two additional steps.

### INSTRUCTOR ACTIVITY

- (5) Display Slide YXP L6-S13, "Removing Heated Component: STRESS - No lifting or pulling force should be used.
- (6) Display Slide YXP L6-S14.

### STUDENT ACTIVITY

639

1234

1233



## THE NATIONAL CENTER MISSION STATEMENT

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Providing information for national planning and policy
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

OUTLINE OF INSTRUCTION

- (a) When removing coating from the component leads, remove the coating down to the pad area exposing the solder connection.

- (b) Completely desolder the component leads prior to heating the component body for removal.

3. Miniature machining or Dremol Kit.

- a. The miniature machining system, provided with the repair unit, is another reliable method of removing conformal coatings.

1235

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1236

640

## FOREWORD

The Educational Resources Information Center on Adult, Career, and Vocational Education (ERIC/ACVE) is one of sixteen clearinghouses in a nationwide information system that is funded by the National Institute of Education. One of the functions of the Clearinghouse is to interpret the literature that is entered in the ERIC data base. This paper should be of particular interest to educational decision-makers and practitioners who are considering how they might deal with credit awarded for experiential learning.

The profession is indebted to Elizabeth Stanley for her scholarship in the preparation of this paper. Recognition also is due Robert Templin, Piedmont (Virginia) Community College; Diana Bamford-Rees, Council for the Advancement of Experiential Learning; and Richard Miguel, The National Center for Research in Vocational Education, for their critical review of the manuscript prior to its final revision and publication. Robert D. Bhaerman, Assistant Director for Career Education at the ERIC Clearinghouse on Adult, Career, and Vocational Education, coordinated the publication's development.

Robert E. Taylor  
Executive Director  
The National Center for  
Research in Vocational  
Education

### OUTLINE OF INSTRUCTION

b. , A wide variety of bits are available with the miniature machining system. These bits allow the removal of various coatings from many different surfaces.

- (1) Module has an epoxy coating which must be removed from solder connections prior to desoldering.

- (2) Expanded view shows the very small size of some circuit conductors and pads.

- (a) Due to the small conductor size and relatively high temperature needed to remove epoxy with heat, there would be a fairly high risk of causing workpiece damage if heat removal methods were used.

### INSTRUCTOR ACTIVITY

- (1) Display Slide YXP L6-S15.

- (2) Display Slide YXP L6-S16.

### STUDENT ACTIVITY

149

1238

1237

## CONTENTS

INTRODUCTION	1
BACKGROUND	3
APPROACHES TO ASSESSING PRIOR LEARNING	6
CREDIT BY EXAMINATION	6
CREDIT RECOMMENDATIONS FOR NONCOLLEGIATE COURSES	7
INDIVIDUALIZED ASSESSMENT	8
EVALUATORS AND FACULTY DEVELOPMENT	19
SPECIAL INTEREST AREAS	20
COSTS AND FEES FOR THE ASSESSMENT OF PRIOR LEARNING	21
QUALITY ASSURANCE AND PROGRAM EVALUATION	24
CONCERNS AND FEARS	24
QUALITY ASSURANCE	25
STANDARDS AND CRITERIA	26
ACCREDITATION	28
PROGRAM OUTCOMES AND RESEARCH	29
FUTURE DIRECTIONS AND IMPLICATIONS	32
APPENDIXES	35
REFERENCES	53

OUTLINE OF INSTRUCTION

(b) When removing hard coatings from small conductors or from large flat surfaces such as the rear of a module, the use of the miniature machine with an abrasive grinding bit is much less likely to cause damage than heat removal methods.

(3) A coarse abrasive bit used to remove a hard coating from a large flat surface on the rear of a module.

(4) A fine abrasive bit is being used to remove a thin conformal coating from a single solder joint.

INSTRUCTOR ACTIVITY

(3) Display Slide YXP L6-S17.

(4) Display Slide YXP L6-S18.

STUDENT ACTIVITY

"extrainstitutional learning" to define learning that is attained outside the sponsorship of legally authorized and accredited post-secondary institutions (Miller and Mills, 1978, p. xvii).

When learning is acquired through participation in structured (and often classroom-based) training programs, the significance of the term "experiential" is questionable. Thus, some institutions simply use a designation of "prior learning," which may then include both experiential and classroom-based learning modes. This description is convenient since the learning outcomes of each are often evaluated within the same process. The term prior learning will be employed here as a convenient general description, but the alternate phrases of prior experiential learning and nonsponsored experiential learning will appear in discussions of the literature.

Most colleges and universities appear to indicate that they will only consider the awarding of credit for the learning outcomes or competencies gained through various learning experiences. The terms "credit for life" or "credit for experience" are misleading and should not be employed.

The publications for this review were identified in several ways. Computer searches, using such descriptors as prior learning, college credits, special degrees, nontraditional, evaluation, and military training, produced a number of pertinent citations. Additional relevant publications were identified through annotated bibliographies (e.g., Stutz and Knapp, 1977, 1978 and Gonzalez and Murphy, 1979), as well as through the examination of selected periodicals since 1978 (e.g., Alternative Higher Education: The Journal of Nontraditional Studies, Change, Journal of Higher Education, Lifelong Learning, and the North Central Association Quarterly.) The publications of the Council for the Advancement of Experiential Learning (CAEL) were particularly valuable. (See Appendixes.) Most of the pertinent publications have appeared since 1970; however, an emphasis was on those appearing since 1975. The references represent a selection of materials related to the topics discussed and are not intended to provide a complete bibliography on the topic.

The audiences for this paper include faculty members, practitioners, administrators, policy-makers, as well as agency or legislative personnel interested in this growing aspect of postsecondary education. An attempt is made to provide sufficient detail to answer questions most often asked by these audiences concerning the adoption of a policy on credit for prior learning and to suggest appropriate resources for further study.

OUTLINE OF INSTRUCTION

(5) Properly performed coating removal task.

(6) Module with conformal coating on closely spaced components. Removal of coating from the small areas around IC leads and between components can be an easy task if the right abrasive bit is used.

(7) The bristle brush bit, is generally the most reliable method of removing coating from confined areas since it is small and will form itself into the shape of the area it is in contact with.

INSTRUCTOR ACTIVITY

(5) Display Slide YXP L6-S19.  
STRESS: The color difference between coated and uncoated areas.

(6) Display Slide YXP L6-S20.

(7) Display Slide YXP L6-S21.

STUDENT ACTIVITY

643

1242

1241



OUTLINE OF INSTRUCTION

(8) The bristle brush is an excellent tool for removing thin coatings completely down to the board surface without causing damage.

(9) Ball mill used to remove coating.

(a) The ball mill is normally used in coating removal, only to take off the majority of a thick coating.

(b) Small ball mills may also be used to remove coating from confined areas around component bodies.

INSTRUCTOR ACTIVITY

(8) Display Slide YXP L6-S22.  
Stress brush can cause serious damage if misused.

(9) Display Slide YXP L6-S23.

STUDENT ACTIVITY

1243

4-3-21

1244

- o Adults should not be required to take courses meant to bring about learning they have already acquired.
- o Nontraditional educational options and programs serve the diverse needs of students.

Green and Sullivan (1975, p. 261) stated this rationale very well when they drew the following conclusion: "Providing working people with lateral entry into a collegiate program on the basis of documented noncollegiate learning is an eminently sensible idea, for requirements that result in duplication of learning are unwise uses of both human and educational resources."

The Task Force on Educational Credit and Credentials of the American Council on Education (Miller and Mills, 1978) identified additional issues concerned with the use and relevance of educational credentials in the work setting; the need to make the present system more comprehensive; and the desire of students to "have their learning, wherever and however attained, incorporated into the credit and credentialing system in order to take advantage of subsequent educational opportunities without duplicating educational experiences and wasting personal resources" (p. 5). The task force concluded that "Postsecondary education's basic system for awarding educational credit and credentials should be retained, but it should be modified to serve more adequately present-day educational and social needs" (p. 3). The fifteen recommendations include statements that postsecondary education institutions "should implement policies and procedures for awarding credit for educational accomplishment attained in extrainstitutional settings ...." (p. 234) and "should give high priority to developing improved, technically sound approaches for evaluating educational accomplishment...." (p. 233).

A final factor which cannot be ignored is that of declining enrollments and accompanying pressures to seek a "new clientele." This economic impetus emphasizes the need for educational institutions which are responsive to those being served and is not necessarily a negative consideration. Carefully developed, implemented, and evaluated, programs for the assessment of prior learning can attract new students, and, along with other adaptations for these students, can be conducted without sacrificing the integrity of the educational environment. In fact, the environment and the educational process may be significantly improved. Subsequent sections of this paper will focus on the processes, programs, and quality concerns which can make this possible.

## APPROACHES TO ASSESSING PRIOR LEARNING

As noted, prior learning may include skills, knowledge, and competency in any college-level curricula areas and may have been acquired in a variety of settings. For these reasons, a number of complementary assessment approaches may be useful. The major types are credit by examination, credit according to recommendations for noncollegiate courses, and individualized assessment, chiefly with portfolios. Radloff (1975) and Valentine (1977) have described these approaches and their implications for higher education.

### CREDIT BY EXAMINATION

Since the mid-1960s, the College-Level Examination Program (CLEP) of the College Entrance Examination Board (CEEB) has been used widely to evaluate knowledge in general as well as specific subject areas. The CLEP General Examinations in English composition, humanities, mathematics, natural and social sciences, and history are designed to measure college-level achievement in each of these five liberal arts areas. Subject examinations in forty-seven areas are designed to measure achievement in specific college courses. In 1979, over 900 test centers offered the examinations on a monthly basis, and over 1800 institutions granted credit on the basis of CLEP Examinations (College Board, 1979). The norms for these examinations are established by administering the examinations to a large number of students completing the appropriate course(s) or, in the case of the general examinations, their sophomore year in college.

### OUTLINE OF INSTRUCTION

- (c) When removing coating with a ball mill, use EXTREME CAUTION and NEVER attempt to remove a coating completely.

- (10) A module that has component leads which must be cut for removal. Note that the leads to be cut are inaccessible to cutting pliers.

- (11) The slotting saw bit may be used to cut inaccessible component leads. EXTREME CAUTION must be used when applying this technique as there is a great danger of causing workpiece damage.

### INSTRUCTOR ACTIVITY

- (10) Display Slide YXP L6-S24.

- (11) Display Slide YXP L6-S25.  
Stress damage CAUTION

### STUDENT ACTIVITY

549

1246

1245

of at least three subject matter specialists nominated by educational institutions, professional societies, and educational and regional accrediting associations. The evaluators observe the classroom and facilities, interview instructors and administrators, and examine course materials. The credit recommendation is developed through the application of evaluative criteria and the use of professional judgment and expertise.

In a more recent extension of this concept, credit recommendations for courses offered by other noncollegiate organizations (businesses, labor unions, professional organizations, cultural organizations, and government) have been prepared by the American Council on Education (1978 d), and jointly by the American Council on Education and the University of the State of New York in the "Project on Noncollegiate Sponsored Instruction" (1976). Using the same evaluation processes and credit categories, a variety of regularly scheduled noncollegiate courses have been evaluated. Institutions may use both sets of guides as standards for credit awards or may refer to the course descriptions and credit recommendations for information while making an individual decision regarding credit for a specified course. In either case, the request for credit, and the ensuing institutional evaluation, is greatly simplified for the student who has completed one or more of the listed courses.

#### INDIVIDUALIZED ASSESSMENT

Despite the apparent utility and relatively high degree of acceptance of the preceding two approaches, more highly individualized assessment techniques are required when the student's prior learning cannot be readily measured by a standardized examination and was not acquired through an evaluated noncollegiate course. Alternative approaches frequently are required for the evaluation of competencies acquired through work, volunteer, and homemaking experiences; through self-directed independent study; or through noncredit courses for which recommendations are not available. A general process based on student-prepared portfolios has been developed at several institutions and includes the following steps identified in several Cooperative Assessment of Experiential Learning (CAEL) publications (Willingham, 1977):

- |            |  |
|------------|--|
| Identify   | Identify college-level learning acquired through life experience.                |
| Articulate | Explain how and what parts of that learning are related to the degree objective. |

### OUTLINE OF INSTRUCTION

- (12) Handling and installing of bits in the miniature machine or Dremel is the same for all of the bits supplied with the repair kit.

### C. Desoldering micro-miniature solder connections.

#### 1. Component Removal

### INSTRUCTOR ACTIVITY

1. The majority of all damage caused during the repair cycle of a module has always happened in the disassembly (component removal) phase of the work and the largest percentage of this damage has occurred during a single operation, DESOLDERING OF COMPONENTS. Explain the urgent necessity for proper micro-electronic repair equipment and training. Modules on the following slides are actual tasks performed by IMA technicians in the field on typical micro-electronic modules.

### STUDENT ACTIVITY

1247

1248

7. The evaluator makes a recommendation of credit, normally to the program director or dean, who may approve, reject, and/or further review the portfolio.
8. After the credit recommendation receives all the appropriate approvals, the information is forwarded to the registrar for transcription.

Numerous variations exist since the process is designed to operate within the framework of varied institutional settings. Appeal processes may be incorporated and evaluation teams may serve in lieu of, or in addition to, individual expert judges. In the following five sections, the major elements of this process will be discussed in more detail.

#### Student Orientation: Facilitating Reentry and Portfolio Assessment

Many of the adults who seek assessment of prior learning are returning to formal education after a gap of five, ten, twenty, or more years; a number are entering college for the first time. They will initially seek information about the institution, its degree programs, and the policies and procedures for assessment of prior learning.

They should be provided with clearly written and complete information. A number may seek assistance in career and educational planning. Despite their obvious competence in noncollegiate activities, many will feel considerable uncertainty regarding the assessment of prior learning outcomes. Individual interviews and group orientation sessions can provide opportunities for discussion and explanations to clarify the process and to indicate the supportive services available.

Several possible institutional arrangements designed to aid the student in the assessment process have been described by Knapp (1977). These include:

- a. Counseling. A counselor works with the student through each stage of the assessment process but is not responsible for recommending credit. The counselor often performs administrative functions for the program. He or she should be skilled in working with adults and knowledgeable about the institution's programs and policies.
- b. Mentoring. A person representing the student's academic area of interest provides guidance in planning and developing a portfolio which relates the student's past learning to his or her other educational

647

### OUTLINE OF INSTRUCTION

- a. A module with a thin, soft polyurethane coating and lap-soldered IC leads. Note the IC removed from the upper right-hand corner.
- b. An attempt was made to use destructive component removal and then to cold peel the remaining lap-soldered lead ends. It is obvious that the destructive portion of the plan was highly successful.
- c. Module worked on by a different technician. Note the IC removed at third position from left in bottom row.
- d. After destructive component removal, an attempt was made to heat and push (shovel) the cut leads off of the pads. Overheat and overpressure caused the missing pads. Note that no attempt was made to remove the coating from the leads.

### INSTRUCTOR ACTIVITY

- a. Display Slide YXP L6-S30.
- b. Display Slide YXP L6-S31.
- c. Display Slide YXP L6-S32.
- d. Display Slide YXP L6-S33.

### STUDENT ACTIVITY

1250

1249



- o Time line, chronological record, or chronology
- o Autobiographical statement
- o Statement of goals
- o Learning descriptions for each subject area

Narrative  
Competency statements  
Credit request  
Documentation

The initial time line or chronological record will include only brief notations and dates and will serve primarily to provide a rapid overview and to assist the student in identifying prior learning experiences. Experiences to be listed may include work experience, education, noncredit courses and seminars, volunteer activities, travel, homemaking activities, licenses, awards, professional organizations, recreational activities and hobbies, independent reading, publications, reports, and military experience.

An autobiography, where required, will provide additional information about the student's activities, but it need not provide extensive detail about the learning experiences if a later thematic narrative is to be included. While some institutions have deleted this requirement, others request it, finding that it gives a helpful view of the student's background and interests. Still others place particular emphasis on the autobiography, reporting that the reflection and self-assessment involved in its preparation provide valuable educational experiences.

In a statement of goals, the student usually is asked to express his or her educational, life, and career goals - and to relate the credit request to the achievement of these goals. Both the autobiography and the goals statement (which may be combined) provide an opportunity for the student to demonstrate the significance of prior learning outcomes with a set of overall objectives. These may include degree requirements and institutional objectives as well as individualized goals.

The heart of the portfolio usually consists of the learning descriptions arranged by academic content area. In these sections, the student is expected to state his or her learning outcomes in terms appropriate to the institution, and to demonstrate their achievement through narrative description and/or documentation. The narrative will include a rather

### OUTLINE OF INSTRUCTION

- e. An F-11 Memory Matrix composed of two closely space PC boards which were interconnected with straight buss wires.
- f. The interconnecting wires were removed by the heat and pull method.
- g. IC removed at lower left-hand corner.
- h. Closeup of IC area. The coating was removed, destructive IC removed, lead ends clipped and cleaned with bristle brush. The original lead ends were left in place with the intention of double lap soldering the new IC in place. A much better attempt than those performed without the repair kit but still not adequate.

### INSTRUCTOR ACTIVITY

- e. Display Slide YXP L6-S34.
- f. Display Slide YXP L6-S35.
- g. Display Slide YXP L6-S36.
- H. Display Slide YXP L6-S37.  
STRESS: Still not adequate.

### STUDENT ACTIVITY

Letters which may help to substantiate many types of learning outcomes are the most common form of documentation used. These may provide either verification of the activity or verification plus an evaluation of the individual's performance. The latter is the most useful. These differ from typical letters of recommendation or commendation. Guidelines on their solicitation and preparation may help to clarify their function (Knapp, 1977).

Overall organization of the portfolio is significant; a general format is provided by most institutions. Students are asked to number all pages, to provide a table of contents, and to carefully relate documentation to appropriate sections of the portfolio. Documentation may be included within each learning description portion or may be gathered in an appendix. Davis and Knapp (1978) have indicated that students spend, on the average, fifty-seven hours preparing a portfolio. It is a challenging process and it can be a significant learning experience.

#### Measurement and Evaluation of Learning Outcomes

Although considered as separate steps in the overall assessment process, the measurement and evaluation stages may be nearly indistinguishable. In instances in which they are separable, the student may be asked to include evidence of the outcomes of measurement of his or her competencies in the form of a letter, completed form, official certification, or score report (Forrest, 1977, p. 73). More frequently, both the measurement and evaluation stages are completed after submission of the portfolio and with an evaluator or assessor selected by the institution.

The selection of evaluators has been discussed by Whitaker (1976), who defined desirable qualifications for evaluators as subject matter expertise, psychometric expertise, familiarity with the data in a particular case, objectivity, and motivation. He also provided tables matching assessor qualifications with assessment functions and potential assessors with assessor characteristics. Institutional choices for evaluators may include the following options, as listed by Knapp (1977):

- o Individual faculty members in a relevant area. This is perhaps the most frequently used arrangement, but it can be the least reliable when only one expert is used. A student often will be evaluated by one faculty member for each academic area or for each course equivalent.
- o Departmental faculty committee. This situation can provide more reliable or accurate evaluations when more

OUTLINE OF INSTRUCTION

i. A multilayer board obvious damage from overheat caused by poor desoldering techniques.

j. Another multilayer board with damage caused by poor desoldering techniques.

2. Vacuum desoldering

a. The most versatile and reliable is the continuous vacuum method.

INSTRUCTOR ACTIVITY

i. Display Slide YXP L6-S38.

j. Display Slide YXP L6-S39.

a. Explain that much desoldering which is very difficult to perform reliably with other methods is a routine matter using continuous vacuum extraction tools.

STUDENT ACTIVITY

b49

1253

1254

Those performing the measurement are urged to consider the use of more than one technique and also are reminded that one technique may be used to measure several learning outcomes. As Knapp (1977) pointed out, the measurement technique selected should: "(1) ...fit the nature of the learning, bearing in mind its individuality, (2) ...be appropriate to the background and characteristics of the learner, and (3) ...reflect student input and participation in that students should be allowed to suggest methods by which they would like their learning outcomes measured" (p. 45)

In a survey by Davis and Knapp (1978), 106 responding institutions reported that "programs have an average of five procedures available with one or all being used by the assessor, depending on the student and the nature of the learning" (p. 30). The methods used most frequently included product assessment, portfolios, interviews, performance tests and objective tests. A frequently used combination for processes which require the student to meet with one or more evaluators is that of the portfolio plus interviews. During the interview (either structured or unstructured), the evaluator is able to question the student in areas of claimed competence, to verify statements made in the portfolio and, if necessary, to request additional information or evidence. This discussion also provides the student with the opportunity to substantiate and augment the portfolio presentation; it can lead to a stimulating interchange with an expert in the field.

With any measurement technique, assessors should attempt to avoid bias or any of the following common types of error, as listed by Willingham (1977): the tendency to rate too liberally or too harshly; the tendency to avoid the extremes of the scale and rate at the average; allowing an outstanding or inferior trait or aspect of performance to influence the rating of other factors (halo effect); judging the ratee according to a personal stereotype or strongly held attitude; the tendency to prejudge the ratee by an initial impression rather than on the basis of observed performance; the tendency to rate a student more favorably if the student is similar to the rater in background, attitude, or ethnic group; the tendency to rate a student lower than average if the previous ratee was outstanding or to rate a student higher than average if the previous ratee was poor (contrast effect) (p. 23-24).

#### Transcription or Recording of Credit Awarded

As in other steps in the assessment process, the transcription or recording of credits or competencies may take various forms. However, it should be consistent with the institutional philosophy. Procedures may vary in terms of timing and format. When an assessment is completed, the student is notified of

### OUTLINE OF INSTRUCTION

- b. Typical example is the multipin sub-module which must have all pins completely desoldered for removal.
- c. Overheating damage is typical of that caused by other desoldering methods, such as the block style desoldering tip for multipin units.
- d. A thin PC board, (approximately 0.008 inch), is very susceptible to heat damage. To make matters worse, boards of this type are often mounted on an insulated metallic substrate, which has a great heat sinking effect, making it necessary to use high heat for desoldering. This condition makes the non-continuous vacuum tools highly undesirable as they often require several reheating operations to completely remove solder from a connection.

### INSTRUCTOR ACTIVITY

- b. Display Slide YXP L6-S40.
- c. Display Slide YXP L6-S41.
- d. Display Slide YXP L6-S42.

### STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

e. A super flat pack received from the manufacturer with excessive solder, causing shorts.

f. Internal view of the same flat pack shows that excessive solder is also causing shorts on the inside of the unit. The solder extractor is ideally suited for removing a large quantity of solder such as this due to its continuous vacuum capabilities.

### 3. Pressure desoldering

a. Another highly valuable desoldering capability of the extractor unit is the continuous pressure (hot air jet) mode.

### INSTRUCTOR ACTIVITY

e. Display Slide YXP L6-S43.

f. Display Slide YXP L6-S44.

### STUDENT ACTIVITY

651

1258

1257

with that for the acceptance of transfer credit is desirable, there may be instances in which credit cannot be awarded because it is no longer possible to demonstrate the competence.

- o Appeal processes. A process for appeals should be established prior to initiation of an assessment program, since cases may arise in which there are disagreements; due process procedures consistent with institutional policies should be available.

Some of the issues for which policies are necessary also are discussed by Meinert and Penney (1975).

## EVALUATORS AND FACULTY DEVELOPMENT

In all processes for the assessment of prior learning, the evaluator or assessor plays a critical role. Individual evaluators with appropriate subject area expertise are most often selected and provide for relatively efficient processes, despite the disadvantage of possible biases and reduced validity due to the use of a single judge. These disadvantages may be partially offset by the addition of an interdisciplinary and experienced review group, although this will entail further costs in money and time.

Recognizing that few faculty members are trained and experienced in both content areas and the application of evaluative techniques to the assessment of experiential learning, a number of institutions and organizations have provided for the development of new skills through faculty development opportunities. These have included locally directed efforts and on-campus programs as well as nationally planned and conducted programs. A program initiated by CAEL in 1975, with partial support from the Lilly Endowment, provided for the "training of trainers" with twelve two-person teams being trained for one year and agreeing to conduct workshops for others during a second year. A "ripple effect" from this program enabled CAEL to provide a greater array of regional and local workshops. In more recent projects, faculty development workshops and training materials have been provided in connection with the CAEL Institutional Development Program (with support from the Kellogg Foundation) and a Fund for the Improvement of Postsecondary Education (FIPSE) funded project of CAEL has emphasized self-directed faculty development in areas related to experiential learning and its assessment.



The opportunities provided through such programs have been substantial and have helped to offset fears that faculty positions will be threatened by growth in experiential learning programs. Benefits also may extend to traditional instructional areas. New or extended skills in the specification of desired learning outcomes and in the use of individualized assessment techniques may be readily transferred and lead to overall improvements in teaching.

#### SPECIAL INTEREST AREAS

While many of the publications in this field consider general procedures, programs, and populations, a number address specific groups or areas of concern. Some have paid particular attention to the assessment of women's experiential learning. These have recognized that many of the competencies acquired by women through homemaking and volunteer activities may be creditable but that their equivalence to college-level learning outcomes may be less obvious than, for example, that of a work-related training program. A handbook prepared for women who are entering or returning to college provides information on assessment processes and guides for the evaluation of learning acquired through homemaking and volunteer activities (Ekstrom et al., 1977). Another study presented preliminary guidelines for the assessment of women's experiential learning in the area of women's studies and included sample portfolio materials describing the actual learning experiences of five women (Sackmary and Hedrick, 1977).

The literature also includes several articles which discussed credit for prior experiential learning in specific curricular areas. Student guides for documenting experiential learning have been prepared by Coastline Community College in office occupation areas including administrative secretary, accounting, office practice, management and marketing, sales and marketing management, personnel associate, and travel agency operation (Coastline Community College, 1979 a, b, c, d, e, f, g). The practices of health administration programs granting credit for prior learning have been discussed by Kleppick (1979). An associate degree program for human service workers, with consideration of the student's prior experiential learning, was described by Duncan et al. (1978). Other researchers have considered credit based on noncollegiate experience in vocational teacher education (Gutcher and Mast, 1977). The assessment of aeronautical educational experiences has been discussed by the Aviation Education Review Organization (1973). Assessment in eight occupational fields (accounting, agribusiness, data processing, day care, electronic technology,

### OUTLINE OF INSTRUCTION

- (1) Hot air at approximately 1000 Degrees F is available when using the extractor in this mode.
- (2) The hot air jet mode can be used to blow solder out of dead end holes when vacuum will not do the job. This mode also gives a unique new desoldering capability, particularly useful in micro-electronics.

- b. A thin film PCB with lap-soldering components. Note high density packaging which makes many leads relatively inaccessible for desoldering. The hot air jet allows you to melt solder and remove lap-soldering leads from a distance if they are inaccessible. It also allows the lead to be desoldered without touching the hot tip to the joint when the pad or board laminate are extremely sensitive to heat and pressure.

### INSTRUCTOR ACTIVITY

- b. Display Slide YXP L6-45.

### STUDENT ACTIVITY

determination of resources and costs, financing, prices, and budgeting. Their report also included technical notes on total, average, and marginal cost. fixed and variable costs, and capital costs. Throughout their study, applications of the processes for the assessment of experiential learning were described.

More recently research on assessment costs has been reported by Woods (1978), who surveyed a number of institutions to determine the average faculty and staff time involvement, plus other costs incurred. He found that an average of 11.32 hours per applicant was expended in institutions not requiring a portfolio preparation seminar and 30.7 hours per applicant in institutions using such a seminar. Advising and counseling account for 3.73 hours and 5.50 hours, respectively. Woods provided a sample worksheet for cost calculations which included other direct and indirect costs as well as personnel. He pointed out that fees or tuition received for a seminar, if held, also must be taken into account. Considering personnel time alone, the seminar might be seriously questioned; however, other positive aspects also should be considered.

A more comprehensive approach, including cost analysis, was taken by Palola and coworkers (1977 a, b) at Empire State College. Their work on Program Effectiveness and Related Costs (PERC) focused on an evaluation of educational effectiveness and analyzed cost data with respect to effectiveness.

The economic impact of credit by examination was explored by three educational economists in a publication edited by Valley (1978). Kendis, Klees, and Wagner reviewed costs and benefits, identified major issues, and suggested further research studies.

Institutions engaged in the start-up of programs for crediting prior learning may find the preceding publications useful for the analysis of program costs. Program planners may also wish to consult MacTaggart's syllabus on cost effectiveness (1979), a manual for self-directed learning for professionals who are establishing models or cost analyzing their own programs. However, it may be necessary to establish initial student fees based on an estimation of costs for a given assessment process. According to respondent in the Davis and Knapp survey (1978), the most common fee arrangements are as follows:

- o Flat assessment fee. The average fee was \$121. This approach was used mostly by public and private four year colleges.

#### OUTLINE OF INSTRUCTION

#### 4. Removal of welded leads

##### a. Cutting the lead

1261

#### INSTRUCTOR ACTIVITY

4. Display Slide YXP L6-S46. Explain that it is often necessary in micro-electronics to repair modules with welded component connections, even though we do not have welding or de-welding capabilities. Using the tools and techniques taught in this course, you will be able to remove welded components and install replacement components by soldering.

- a. The first step in the removal of welded components is to cut the component lead.

#### STUDENT ACTIVITY

653

1262

## QUALITY ASSURANCE AND PROGRAM EVALUATION

### CONCERNS AND FEARS

The practice of awarding credit on the basis of assessment of prior learning has been widely, but certainly not universally, accepted. Those who object often express fears that institutions will "give away" credit, that degrees will be "watered down," or that, in a struggle for survival, colleges and universities will advertise programs of questionable quality solely as a marketing and recruiting tool. These fears are probably healthy ones. They point to the need for quality control and the maintenance of sound academic standards. Sawhill has stated that "the first step in assuring quality in the field of lifelong learning is for each institution to police what it offers to adults according to the same standards it applies to more traditional programs and to monitor its promotion of adult programs by the criterion of 'truth in packaging' (1978/79, p. 7). Sawhill also indicated that "when adults can demonstrate that certain of their experiences are comparable to existing courses at an institution, the practice of awarding credit is appropriate and respectable. When credits are simply dangled in a bid for student dollars, without a firm academic basis, the practice is disreputable" (p. 7). With appropriate quality controls, credit for prior learning can be a strong and rigorous element of an academic degree program, providing well-deserved recognition for learning which takes place outside of the college environment.

Critics also express the concern that faculty members will be displaced if students receive credit through evaluation instead of through classroom participation. In response, it should be pointed out that faculty members typically participate in the assessment process and, thus, continue to play a significant,

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- (1) The welded lead is cut between the weld joint and the component (normally using cutting pliers) being very careful not to damage the pad or welded piece of lead which remains on the PCB.

- (2) The lead must be cut at the edge of the pad area.

b. Dressing lead

- (1) When the welded component has been cut free and removed, the remaining welded lead ends must be properly dressed and prepared so that a replacement component may be soldered (rather than welded) in place.

1263

1264

654

In seeking to assure quality, program planners and practitioners are advised to design and implement the procedures and guidelines suggested by Willingham (1977). The principles presented, drawn from earlier CAEL publications, provide a useful set of guidelines for assessment and administration of such activities. Willingham stressed the need for institutions to clearly articulate the program rationale, to define institutional policies regarding assessment, and to clearly state degree and program requirements. In a section on quality assurance, he recommended that professional standards be fostered, that there be systematic review of the assessment procedures and results of assessment, that there be clear administrative responsibility for monitoring quality, and that periodic checks be made to insure adherence to institutional guidelines.

A number of the significant elements in quality assurance were discussed in other sections of this paper. These include the selection of well-qualified assessors, faculty development and training in assessment techniques, the provision of faculty and student guides, the definition of standards and criteria, the conduct of studies on outcomes, and the reliability and validity of assessment procedures. Additionally, it is most important that the institution foster a sense of quality in all aspects of its activities, that expected learning outcomes and degree requirements be clearly defined, and that students themselves be encouraged to seek and uphold quality in their own educational programs.

#### STANDARDS AND CRITERIA

Valid and reliable processes for the assessment of prior learning require the establishment of appropriate criteria or standards defining the types and levels of competence or learning which may be recognized with college credit. While this may seem to be obvious, and is seldom disputed, it also is relatively seldom that criterion standards or behavioral objectives are explicitly presented. The terms "criterion standard" and "performance standard" have been defined to refer to both the "criteria for deciding what type of learning will be eligible for college credit and the level or degree of evidence of student learning that will be considered adequate for the award of a specific amount of credit" (Fremer, 1976, p. 17). The properties of good standards and the setting of performance standards have been discussed both by Fremer (1976) and Reilly (1977); they also both refer the reader to further technical resources.

Standards may be expressed generally in the form of stated requirements and expectations or may be indicated more

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

- (2) The welded lead tip is next smoothed down flat so that it may serve as a pad area for lap soldering the replacement component of the PCB.

- (3) Since most welded leads are gold-plated non-solderable metal, care must be taken not to damage or remove the solderable gold plating from the lead.

- (4) If the lead is unplated, there are two methods of preparation which will allow soldering of a replacement component.

- (a) The unplated lead may be electroplated with gold so that it becomes solderable.

655

1266



## ACCREDITATION

The assessment of nontraditional education - with concerns for both quality assurance and accreditation - was studied extensively in a national project of the Council on Postsecondary Accreditation (COPA). As reported by Andrews (1979), general strengths of nontraditional education included the support of concepts by educational administrators, the quality of programs offered, and expanded educational services for the older, often employed student. Problems included institutional movement into new programs without complete development, the "entrepreneur with charlatan motives" (p. 343), and the use of traditional degrees without adequate attention given to their normal content. It was noted that most institutions involved in nontraditional education are accredited and that the regional accrediting associations have not had procedural difficulties in accomplishing their accreditation. It was recommended that the normal process-oriented model of evaluation be modified, changing to a process performance model which would accommodate both traditional and nontraditional programs. A number of recommendations, relating to both quality assurance and accreditation, were directed toward postsecondary education in general, nontraditional education, accrediting associations, and the Council on Postsecondary Education. For nontraditional education, it was recommended that educators work to "integrate the nontraditional movement into the mainstream of conventional institutions and programs"; that nontraditionalists exercise caution in establishing external relationships, maintaining unquestionable institutional integrity; and that adequate processes and support components be developed and implemented (p. 353-354). While generally written for nontraditional programs, the recommendations were clearly appropriate for programs for the assessment of prior learning.

Thrash (1978) also emphasized that there should not be a dichotomy between traditional and nontraditional programs and separate accreditation processes for each. Rather, "... it (the accrediting commission) must develop a series of evaluative procedures that can be applied to all institutions to assess effectively the educational quality of those institutions, whatever the learning options offered" (p. 463). Thrash also has discussed the responsiveness of the regional accrediting associations to the assessment needs of nontraditional programs, describing the accreditation process (Thrash, 1979-a) and the development of a sequential evaluation process for institutions with a number of off-campus programs (Thrash, 1979 b).

OUTLINE OF INSTRUCTION

(b) The welded lead may be removed completely by abrasive methods and the replacement component soldered to the board circuitry. This method is the least desirable for two reasons:

1. While completely removing the lead, there is a very high risk of damaging the board circuitry.
2. The solder joint on the board circuitry must be allowed to have a gap on it or the area must be plated since the spot where the weld connection was formed will be non-solderable.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1,500 graduates. Similar findings regarding student characteristics, goals, and program outcomes were reported. This study also noted that the average student was thirty-six years old, that most were employed, three-quarters were married, a quarter were black and almost half were women. They came from a wide variety of backgrounds and many had attended more than three other colleges (although some had no previous college experience). Over three-quarters of the graduates received credit for prior learning, earning an average of thirty-seven semester hours. Credit for prior learning was awarded in all major academic areas, with the largest number of awards in business and management, education, health professions, and social sciences. Approximately 12 percent received credit by proficiency examination and 22 percent for military service. Both graduates and their employers were satisfied with their degrees; graduates indicated substantial achievement of their career, educational, and personal goals. Nearly half of the graduates applied to graduate schools. Of these, over 90 percent had been admitted at the time of the study.

Additional studies on this program were conducted during 1978-79 as part of a project on the evaluation of nontraditional programs. In these studies, information was gathered on faculty attitudes, persons who inquired but did not enroll, students who did not complete the degree, as well as on enrolled students and graduates. During 1979-80, similar studies were conducted at seven additional institutions. The research efforts included the testing of a sample of graduates, using the American College Testing (ACT) Program and The College Outcome Measures Project (COMP) examinations, designed to "measure and evaluate the knowledge and skills that undergraduate students are expected to acquire as a result of general or liberal education programs and that are important to effective functioning in adult society" (Forrest and Steel, 1978, p. 1). A product of this study also has been a useful annotated bibliography on the evaluation of nontraditional programs (Gonzalez and Murphy, 1979). The project codirectors expect to provide a model which will be useful in future evaluation projects (Murphy and Pringle, 1979).

The characteristics of students who received credit for prior learning also have been reported by Spille and Hartley (1975) at the University of Wisconsin-Green Bay, and by Lutz (1978), who described enrollees in Connecticut's extended degree program, the Board for State Academic Awards. The experiences of graduates of nontraditional programs have been discussed by Losty and Gardinor (1978) at Stephens College and by Beshiri (1978), who compared graduates of traditional and nontraditional programs at Florida International University. Palola and Bradley (1973) and Lehmann (1974) reported on studies of early

OUTLINE OF INSTRUCTION

D. Use and capabilities of desoldering tools.

1. Solder extractor

a. Reliable Extraction Procedures

- (1) Always use a stirring motion of the lead if possible, so that no sweat joints remain after desoldering (this is particularly important with multilead components)

INSTRUCTOR ACTIVITY

- a. Briefly review extractor use.

STUDENT ACTIVITY

657

270

### OUTLINE OF INSTRUCTION

(2) Except for very rare instances where you have no alternative, NEVER allow the extractor tip to contact the board laminate or conductors.

(3) The desoldering of lead terminations, which are not straight through, can be greatly simplified by using micro-miniature tools and techniques.

(a) The normal process is to extract all solder possible and then mechanically shear the remaining sweat joint with pliers. The shearing operation presents some risk of workpiece damage.

### INSTRUCTOR ACTIVITY

(3) Display Slide YXP L6-547.

### STUDENT ACTIVITY

access to higher education by making arrangements for appropriate schedules, locations, and services. She also wrote that "There is widespread agreement now that traditional time-serving measures of learning are not adequate for the learning society" (p. 45). Cross concluded that a desirable development would be a central assessment agency or a network of assessment centers which would evaluate competencies and report to institutions designated by the candidate. A proposal such as this one is certain to raise objections; nevertheless, it is pointed out that institutions retain the responsibility of setting standards for acceptance. Centralized assessment services have, in the past, met with opposition. Some may have been questioned justifiably. Given adequate quality assurance measures and responsiveness to both individual and institutional needs, they do represent a possibility for the future.

To fully serve adult learners, additional needs exist for the provision of information on learning resources. Educational Information Centers (EICs) and educational brokers help to meet these needs. Expansion of these services will be necessary in order to provide adequate information to adults as consumers. Additionally, directories listing programs for the assessment of prior learning, such as one published recently by CAEL (Beechem, 1979) can be made available through public libraries and employers as well as colleges and universities. Popular magazine and newspaper articles can help inform adults of the opportunities available. In a relatively new area, CAEL has initiated efforts at combining educational and career-planning approaches, modifying existing computer-based career information systems. Interactive computer systems also may be used to assist students with portfolio development and to provide access to information on institutional assessment programs and their requirements.

Experiential learning also serves as an important connection between work and education, significant in the implementation of policies for lifelong learning. Cooperation between educational institutions and those who provide learning resources in other settings is becoming increasingly important. The recognition of learning, wherever it occurs, and the enhancement of the quality of that learning and of its evaluation can help to integrate education with work and leisure.

In order to attain the goals of the learning society, state and federal policies also need continued modification to effectively serve the needs of the adult, often part-time, student. Funding formulas and financial aid packages should encourage the flexibility required by nontraditional students and should accommodate options for the assessment of prior learning without penalty to the student or institution. Specific institutional

policy issues have been addressed previously. In a more general sense, institutions may wish to review their overall philosophy with regard to its impact on adult students.

Projections of declining undergraduate enrollments of eighteen to twenty-one year olds also have been emphasized, and have had considerable impact upon educational planning. The final report of the Carnegie Council on Policy Studies in Higher Education (1980), Three Thousand Futures: The Next Twenty Years in Higher Education, predicted enrollment declines of 5 to 15 percent between 1980 and 2000. The report suggested that although severe problems lie ahead, reasonable solutions exist for most of them. Adult students may not save the institutions which are most severely affected by declining enrollments during this period; however, the encouragement of adult enrollment and degree completion can help to offset the losses and provide part of the solution.

In addition to providing a service to those adults who seek academic credentials and attracting such adults to institutions which seek a "new clientele," programs for the assessment of prior learning can exert other significant influences on higher education (Shulman, 1978). In an analysis prepared for the American Council on Education Task Force on Educational Credit and Credentials, Ferguson (1978) stated that "Recent developments in postsecondary education portend significant changes in the future. It may well be that postsecondary institutions, as they face up to the needs and demands of their students and potential students, will also increase their attention to the evaluation of student achievement of intended outcomes of their educational programs" (p. 129). The assessment of prior learning is based upon such evaluation. The questions and concerns it raises are important in determining the future directions of postsecondary education.

OUTLINE OF INSTRUCTION

(b) The thermal parting tool may be used in place of the shearing operation. This will greatly reduce the risk of causing damage.

(c) After extracting all the solder possible adjust the parting tool to solder melting temperature and use it to lift (NEVER PRY) the lead to a straight through position.

(d) When the leads have been lifted, the extractor may be used with the stirring action to completely desolder the lead.

INSTRUCTOR ACTIVITY

(c) Stress "Never Pry".

STUDENT ACTIVITY

659

271

1273

4-3-37



## APPENDIX A: CURRENT CAEL PUBLICATIONS

The following publications are available from CAEL, American City Building, Suite 212, Columbia, Maryland 21044

1. CAEL Literature Guide, Jane Porter Stutz and Joan Knapp, 1978.

There is a large and diffuse body of literature somehow related to experiential learning, but relatively few, mostly recent, items deal specifically with the theory and practice of assessing experiential learning. This annotated bibliography contains a number of items that CAEL has found particularly helpful in one connection or another through its work in recent years. They cover a variety of topics, including some important literature with which practitioners in this area are not typically familiar, but most of the references deal specifically with the particular types of problems on which CAEL has placed special emphasis.

2. CAEL Literature Guide Supplement, Jane Porter Stutz and Joan Knapp, 1978.

An update to item No. 1 (May be purchased separately or in combination with item number 1.)

3. CAEL Directory of Members

Each year CAEL produces an updated annual Assembly Directory. It lists all current institutional members, including official representatives and addresses. Associate members are also listed.

OUTLINE OF INSTRUCTION

(4) New techniques of solder extraction which apply to micro-miniature repair are those of extensive extractor tip modification to allow desoldering of a wide variety of small sized and odd shaped connections.

(a) Since extractor tips will not fit the miniature machine chuck, they may be wedged over a ball mill which will allow them to be rotated for modification.

(b) A comparison between a modified and an unmodified tip.

(c) The inside of the tip may also be ground out to fit special shapes or sizes of leads.

INSTRUCTOR ACTIVITY

(a) Display Slide YXP L6-S48.

(b) Display Slide YXP L6-S50.

STUDENT ACTIVITY

1276

099

and utilizing potential experiential learning situations, and assessing the learning of interpersonal skills for academic credit. A core program of assessment strategies is outlined emphasizing the need for multiple techniques.

8. Assessing Prior Learning - A CAEL Handbook, Joan Knapp, 1977.

Different institutions assess and credit prior experience in different ways. One of CAEL's primary objectives is to develop sound general procedures for such assessment and to suggest alternative ways that important basic steps can be carried out. This handbook is a good illustration of that developmental objective. It presents a model for portfolio assessment that incorporates eight stages - (1) facilitating the construction and assessment of a portfolio, (2) identifying significant prior experiences, (3) expressing the learning outcomes of prior experiences, (4) articulating prior outcomes to educational goals, (5) documenting the learning experience, (6) measuring the extent and level of prior learning outcomes, (7) judging the learning outcomes, (8) and evaluating prior learning outcomes for awarding credits or recognition. At each stage alternative practical procedures are suggested. (Companion to item number 13.)

9. Assessing Occupational Competencies - A CAEL Handbook, Amiel T. Sharon, 1977.

This handbook describes a model for assessing specific competencies acquired in work situations that are relevant to occupationally oriented degree programs. The model is designed to help a college specify the kinds of competencies acquired in various occupational settings, to define the learning objectives of occupational and career programs, and to translate the competencies into college credit where appropriate. The report describes the application of the model to three fields (data processing, law enforcement, and secretarial science) and shows how the model can be applied to other occupations. Prototype assessment instruments and procedures are included.

OUTLINE OF INSTRUCTION

(d) You can and should modify your extractor tips to any shape needed when it will result in more efficient solder extraction.

2. Hot air jet

a. Technique for removing lap-soldered leads with the hot air jet is as follows:

(1) Connect the solder extractor to the pressure supply and set the pressure flow control to MINIMUM.

INSTRUCTOR ACTIVITY

(d) Display Slide YXP L6-S51.

2. The hot air jet technique is extremely useful for removing lap-soldered component leads.

STUDENT ACTIVITY

and it is based on the same theoretical framework and contains some identical sections. The special contributions of the student guide are chapters on planning for experiential learning and preparing for assessment. Detailed suggestions are offered for preparing a life goal autobiography, articulating personal goals to interpersonal development, and selecting an experiential learning site.

13. Assessing Prior Learning - A CAEL Student Guide, Aubrey Forrest, 1977.

It is typically the adult student who petitions for college credit based upon prior experiential learning, and this student guide is directed to that audience. The purpose is to assist such adults in maximizing the value of their prior learning in relation to educational goals and successfully obtaining appropriate credit. The reader is led step by step through the process of identifying learning outcomes, relating them to educational goals, documenting experience, measuring learning outcomes, and requesting credit or recognition. (Coordinated with item number 4).

14. College-Sponsored Experiential Learning - A CAEL Student Guide, Hodley Nesbitt, 1977.

This student guide is designed to help students make the most of the off-campus experiential learning. It is organized around eleven basic steps. These include: selecting and preparing for the learning experience, involvement in the work situation, and integrating the learning derived from the experience into an ongoing academic program. Charts, checklists, and worksheets serve as aids for dealing effectively with each of the eleven steps. (This Guide is coordinated with item number 11).

15. Developing Program Maps, Module 1, Marvin Cook, 1976.

CAEL holds that a program unexamined as to outcomes is less likely to be sound than one with clarified outcomes. This module is designed to train faculty and staff as to how to develop program maps of their academic programs. The maps are used in many ways, including identifying "GAPS" in existing college programs, designing individual degree programs, developing extended degree programs, developing new departmental programs, and providing a rational basis for awarding credit for prior learning. Many examples of program maps in a number of academic areas are included.

OUTLINE OF INSTRUCTIONINSTRUCTOR ACTIVITYSTUDENT ACTIVITY

- (2) Adjust the temperature to MAXIMUM and vary the amount of heat applied to the solder joint by varying the distance between the extractor tip and the joint.
- (3) Gently grip the lead with tweezers and blow hot air on the connection.
- (4) When a solder melt is observed, lift the lead carefully and remove the hot air flow.
- (5) When correct flow, temperature and distance are used, the solder melt should occur in approximately 2 seconds.

19. Lifelong Learning: Purposes and Priorities, K. Patricia Cross, 1979.

The author, a Distinguished Research Scientist at Educational Testing Service, refers to the current times as the "renaissance of education for adults" because, she says, "It represents a rebirth of attention to the life of the mind that is as significant to the twenty-first century as the original intellectual renaissance was to the fifteenth century." Researchers estimate that between 80 and 90 percent of the adult population carry out at least one self-directed learning project each year and that the typical adult spends about 500 hours per year learning new things from a variety of sources (Tough, 1977). This eighteen page paper was prepared for a Sectional Assembly of CAEL in early 1979. Dr. Cross concludes by stating that she views the role of educators as to: help people of all ages develop a taste for good learning experiences and to choose from a wide variety of learning resources those which best meet their needs at the time."

20. Cost Effectiveness: A CAEL Syllabus for Professionals, Terrence MacTaggart, 1979.

This syllabus is designed for those program managers, faculty, and student advisors who feel the need to learn how relevant economic concepts can enrich their decision-making skills. The first part of the syllabus suggests a path of study which will enable the learner to analyze, compare, and evaluate alternative programs in light of the principles of cost effectiveness. The second section assists the learner in developing an alternative choice model for the prospective student who must select among educational options. The syllabus emphasizes the value of economic concepts in criteria which bear on the decision process.

21. The Self-Directed Educator: A CAEL Syllabus, Mark Cheren, 1979.

Continuing professional development requires the performance of a difficult and complex set of tasks. This syllabus acknowledges the difficulty of self-development efforts undertaken by professionals and attempts to assist such efforts. Its purpose is to facilitate the enhancement of current self-development skills and where appropriate to support the acquisition of new skills useful in such activities. The syllabus is intended for use by a wide range of professionals in higher education, particularly those seeking to learn the new skills involved in more innovative practice.

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

663

NOTE: NEVER apply any lifting pressure to any lead when using this method prior to observing a COMPLETE solder melt.

(6) Typical hot air jet desoldering operation.

(6) Display Slide YXP L6-552. Remember to alternate the operation from one side of component to another, so that there is no excessive heat buildup in a single area.

3. Miniature machine or Moto Tool

- a. The miniature machine is classified as a desoldering tool when used in the removal of welded leads.

1282



25. Developing Assessment Tasks, Module 3, Marvin Cook and Henry H. Walbesser, 1980.

The validation of the quality of educational programs includes the need to assure that students in the programs have actually acquired the intellectual skills identified in the statements of college learning outcomes. Module 3 is designed to be used in faculty workshops focusing on the development of assessment tasks that "match" stated learning outcomes. The many exercises in the Module provide an opportunity for workshop participants to become proficient in the use of the performance agreement principle, to establish the validity of their assessment tasks, and thus contribute to the assurances of the quality of their educational programs.

26. Using Licenses and Certificates as Evidence of College-Level Learning, Harriet W. Cabell, edited by Ruth Cargo, with introduction by Henry Spille, 1980.

This report confirms that considerable college-level learning is required to obtain certain certificates and licenses. It also demonstrates that the learning represented by the certificates and licenses can be - and, in fact, is being - assessed and equated to the learning outcomes of educational programs offered by colleges and universities. The report identifies services needed by institutions and provides specific recommendations for answering those needs. Commissioned jointly by ACE and CAEL, the booklet is based on original research performed in fulfillment of a doctoral degree. Highlights have been selected and a shorter version rewritten for busy practitioners. An appendix reproduces the research questionnaire and the data from which the findings and recommendations derive.

### OUTLINE OF INSTRUCTION

- b. It may be used to cut the leads when they are not accessible with pliers but great care must be taken not to cause workpiece damage.
- c. The miniature machine is also used to clean and smooth sharp edges on the remaining lead after the component has been cut away.
- d. It may also be used to grind away the welded lead end when necessary, must be used with great caution to avoid causing damage. NEVER attempt to separate a welded joint with heat or pressure as circuit conductor damage will almost invariably result.

1283

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

1284

699

### OUTLINE OF INSTRUCTION

E. Evaluating disassembly for completeness and quality.

1. Coating removal :-

- a. Completeness - check that all coating removal necessary for the entire repair cycle of the work-piece has been performed and that no part of the remaining coating will interfere with future repair, component mounting, or soldering.

1285

### INSTRUCTOR ACTIVITY

E. Display Slide YXP L6-S53.

1. State that all steps of the disassembly process must be thoroughly evaluated for completeness and quality before making ANY repair or replacement action.

### STUDENT ACTIVITY

665

1286

This report extends the position that the highest purpose of education is to foster both community and individual self-reliance. It describes the process and materials developed to help students and local review committees agree on standards that are unique to student goals, that accurately reflect community expectations, and that conform to the institution's educational principles. It lists the steps through which both the student and committee go in the degree development sequence.

6. Implementing and Financing Portfolio Assessment in a Public Institution, Eugene Kray and Lorraine Hultgren, A CAEL Institutional Report from Delaware County Community College, 1976. (ED 148 851)

The authors first describe the formation, organization, philosophy, and structure of DCCC's program for assessing prior experiential learning. The heart of the report presents a financial model in which (1) all parties - student, state, and local sponsor - share in the cost of assessment in the same proportions as they do for the traditional programs of the college, (2) faculty members are compensated for their time on a contact hour basis according to the number of credits sought by the student - not the number of credits awarded; and (3) the cost of assessment is shown to be approximately one-fourth the cost of traditional course work. This model should be of general interest to both two-year and four-year public colleges.

7. Prospects and Methods for Interpersonal Studies, Miriam Tatzel, CAEL Institutional Report No. 2 from Empire State College (Revised Edition), 1977. (ED 148 847)

At Empire State College students work with a mentor to develop learning contracts. This institutional report shows how interpersonal learning is integrated into the formal educational process through the learning contract mode. The author describes a framework that takes into account cognitive, affective, and physical behavior; that is, thought, feeling, and action.

8. Implementing Competency-Based Assessment of Prior Learning, Nancy Wylie, A CAEL Institutional Report from Florida International University, 1976. (ED 148 854)

This report describes the development, trial use, and revision of a competency-based tool for assessing prior learning, the Prior Experiential Learning Evaluation Packet. The author explains the integration of the new assessment process within an existing external degree program; describes

how the external degree program and its students interact with other administrative and academic units of the University; and discusses explicit and implicit standards and their implications for assessment in a context in which the responsibility for assessment is partially decentralized.

9. An Individualized Competence-Based Assessment Model, Annie Belle Calhoun, James E. Deegan, Leah Harvey, and Charles Libera, A CAEL Institutional Report from Metropolitan State University, 1976. (ED 148 839)

Metropolitan State University is an upper-division, competence-based, baccalaureate degree granting institution created in 1971 to serve adults. This operational model focuses on topics such as criterion standards within the context of an individualized, student-centered, competence-based program; the use of external or community-based persons as expert judges of students' competences; the functions and activities of assessment faculty; the strengths and weaknesses of the narrative transcript; and the effectiveness of the university's assessment policies, procedures, and materials.

10. Documentation and Evaluation of Sponsored Experiential Learning, Jane Szutu Permaul and Marina Buhler Miko, CAEL Institutional Report No. 3 from University of California at Los Angeles (Revised Edition), 1977. (ED 148 858)

A major problem in assessing off-campus experiential learning is the need to structure the learning process and document the learning outcomes. This report describes the procedure developed at UCLA that explicates the learning that is taking place and therefore helps to shape and improve subsequent learning experiences of the student. The method focuses upon a record-reflection log and an assessment matrix as tools for assessing sponsored learning. These devices emphasize the role of the student and local supervisors in evaluating and molding learning outcomes.

11. The Refinement and Modification of an Instrument for Assessing the Achievement of Interpersonal Skills of Social Work Students, Kurt Spitzer and Sue Smock, CAEL Institutional Report No. 4 from Wayne State University, 1975. (ED 148 857)

Students engage in many types of field experience learning in different types of settings and in different degree programs. This report is especially concerned with field experience related to social work, but the learning

### OUTLINE OF INSTRUCTION

- b. Quality - check that no work-piece damage has been caused and that all remaining coating is free of charring, cracking, or debonding.

### 2. Desoldering

- a. Completeness - check that all desoldering necessary to the entire repair has been performed and that all desoldered holes and pads are free of excess solder.

- b. Quality - check that no board or conductor damage has been caused

### INSTRUCTOR ACTIVITY

- 2. The next step is to check all desoldering operations for completeness and quality.

### STUDENT ACTIVITY

1288

1287

999

traditional decentralized system to introduce flexibility in the use of challenge examinations for crediting prior learning. Richard Ranta's report (Memphis State University) describes how a large traditional state university dealt with the issues involved in specifying criteria for assessing experiential learning, acquainting faculty with the assessment process, and integrating those procedures into the university structure. The report by Dale Meyers and Joe Thomas (Union College) describes the development of a central office for sponsored field experience learning in a liberal arts institution. The report by Barbara Hofer, Robert Sexton, and Ernest Yanarella (University of Kentucky) provides a model for integrating experiential learning in the liberal arts, especially with respect to the curriculum's emphasis upon values and ethics.

### OUTLINE OF INSTRUCTION

#### 3. Welded lead preparation

- a. Completeness - check that all leads have been cut, cleaned and smoothed so that they are suitable as a solder pad for replacement components.
- b. Quality - Check that no work-piece damage has been caused during lead preparation and that soldering plating is complete and undamaged to permit reliable soldering.

#### 4. Workpiece damage

### INSTRUCTOR ACTIVITY

- 3. The next step is to check the preparation of all welded leads (if any) for completeness and quality.
- 4. Careful evaluation must how be performed on any workpiece damage found in the previous steps.

### STUDENT ACTIVITY

667

1290



4. Transferring Experiential Credit describes ways for experiential educators to overcome two key problems: (1) assuring that credit is awarded not for experience alone but for college-level learning resulting from experience, and (2) ensuring equitable transfer of experiential learning credit. Guest editors are S.V. Martorana, professor of higher education at Pennsylvania State University, and Eileen Kuhns, program coordinator for educational administration programs, Catholic University of America. (1979)
5. Combining Career Development with Experiential Learning shows how to design educational work experiences that meet the career development needs of individual students. Various career counseling tools, such as self-assessment instruments and life planning exercises, are explained. Frank van Aalst, dean of career development at the College of Charleston in South Carolina, is the guest editor. (1979)
6. Enriching the Liberal Arts Through Experiential Learning describes new ways to improve liberal arts education by introducing both field experience and classroom experiential exercises into traditional curriculums. The editors are James Althof of the Appalachia Educational Laboratory and Stevens Brooks, executive director of the Great Lakes Colleges Association's Philadelphia urban semester. (1979)

OUTLINE OF INSTRUCTION

- a. Determine if any hidden damage was discovered as a result of disassembly and if so, incorporate its repair into the overall repair task analysis.
- b. Determine if any workpiece damage was caused by disassembly and if so, take the following steps.
  - (1) Evaluate the cause of the damage and take immediate action to insure that similar damage is not caused on future workpieces.
  - (2) Incorporate repair of the damage into the overall repair task analysis.

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1291

1292

899

Beshiri, P. H. "Answering the Critics: A Comparative Study of External Degree and Traditional Graduates." Alternative Higher Education. 2(1978): 195-209.

The Board of Governors Bachelor of Arts Degree Program: Five Years of Experience: A Study. Springfield, Illinois: Board of Governors of State Colleges and Universities, 1978. (ED 160 037)

Bowen, H. R. "Financing the External Degree." Journal of Higher Education. 44(1973): 479-491.

Carnegie Commission on Higher Education. Less Time, More Options: Education Beyond the High School. New York: McGraw-Hill, 1971.

Carnegie Council on Policy Studies in Higher Education. Three Thousand Futures: The Next Twenty Years for Higher Education. San Francisco, California: Jossey-Bass, Inc., 1980.

Churchill, R. "Development of a Competency-Based Scale for Writing." The CAEL Validation Report. Princeton, New Jersey: Cooperative Assessment of Experiential Learning, W.W. Willingham and Associates, 1976.

Coastline Community College. Student Guide for Documenting Experiential Learning: Accounting. Fountain Valley, California: Coastline Community College, 1979a. (ED 176 836)

\_\_\_\_\_. Student Guide for Documenting Experiential Learning: Administrative Secretary. Fountain Valley, California: Coastline Community College, 1979b. (ED 176 837)

\_\_\_\_\_. Student Guide for Documenting Experiential Learning: Business Management and Marketing. Fountain Valley, California: Coastline Community College, 1979c. (ED 176 834)

\_\_\_\_\_. Student Guide for Documenting Experiential Learning: General Office Practice. Fountain Valley, California: Coastline Community College, 1979d. (ED 176 835)

\_\_\_\_\_. Student Guide for Documenting Experiential Learning: Personnel Associate. Fountain Valley, California: Coastline Community College, 1979e. (ED 176 838)

\_\_\_\_\_. Student Guide for Documenting Experiential Learning: Sales and Marketing Management. Fountain Valley, California: Coastline Community College, 1979f. (ED 176 839)

### OUTLINE OF INSTRUCTION

F. Safety precautions

H. Demonstration

1. Micro coating removal and desoldering demonstration

### III. APPLICATION

A. Performance Sheet 4-3-1P

1293

### INSTRUCTOR ACTIVITY

- F. Display Slide YXP L6-S54, and review the safety precautions previously presented.

1. Instructor should demonstrate the proper techniques and use of tools while showing students how to remove coating and desolder micro-electronic circuit boards covered during lesson.

A. Supervise each students completion of Performance Sheet 4-3-1P, emphasizing safety.

### STUDENT ACTIVITY

1. Observe and ask questions as necessary.

A. Complete Performance Sheet 4-3-1P. Ask question if procedures not clear.

1294

699

- Gonzalez, R.B. and Murphy, L.R. Evaluating Non-Traditional Programs: An Annotated Bibliography. Springfield, Illinois: Board of Governors of State Colleges and Universities, 1979.
- Green, M.H. and Sullivan, J.J. "Credit for Noncollegiate Learning." Educational Record. (Fall 1975): 257-261.
- Gutcher, D. and Mast, W. "College Credit for Non-Traditional Learning Experiences: An Historical Perspective." Journal of Industrial Teacher Education. 14(November 4, 1977): 56-62. (EJ 167 202)
- Heermann, B.C. A Student Guide to Receiving Credit for Prior Learning. Dayton, Ohio: Sinclair Community College, 1977.
- Houle, C.O. "Deep Traditions of Experiential Learning." Experiential Learning: Rationale, Characteristics, and Assessment. San Francisco, California: Jossey-Bass, Inc.; M. Keeton and Associates, 1976.
- Jacobs, P.I. "The Use of Expert Judgement in the Pre-Graduation Conference." The CAEL Validation Report. Princeton, New Jersey: W.W. Willingham and Associates, Cooperative Assessment of Experiential Learning, 1976.
- Jacobson, M.S. Night and Day: The Interaction Between an Academic Institution and Its Evening College. Metuchen, New Jersey: Scarecrow Press, 1970.
- Jamison, D. T. and Wolfe, B.B. "Assessment and Accreditation: Economic Considerations." Implementing a Program for Assessing Experiential Learning. Edited by W.W. Willingham and H.S. Nesbitt. Princeton, New Jersey: Cooperative Assessment of Experiential Learning, 1976.
- Keeton, M.T. "Assuring the Quality of Educational Programs." Learning by Experience - What, Why, How. Edited by M.T. Keeton and P.J. Tate. San Francisco, California: Jossey-Bass, Inc., 1978.
- Kelley, R.L., MacTaggart, T.J., and Spencer, R.A. Analyzing Costs in the Assessment of Prior Learning. Princeton, New Jersey: Cooperative Assessment of Experiential Learning, 1976. (ED 143 853)
- Kleppick, A.L. Crediting of Prior Experience (Alternatives for Meeting Credit Requirements). Report No. HRP-0901507. Washington, D.C.: Department of Health, Education, and Welfare, 1979. (ED 176 626)

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

IV. SUMMARY

A. Introduction

A. Emphasize importance of the summary for the student.

1. Nature of summary.

2. Purpose of summary

B. Directions to student

1. Questions

2. Notes

1296

670

- MacTaggart, T. Cost Effectiveness: A CAEL Syllabus for Professionals. Columbia, Maryland: Council for the Advancement of Experiential Learning, 1979.
- Martorana, S.V. and Kuhns, E., eds. Transferring Experiential Credit, New Dimensions in Experiential Learning Number 4. San Francisco: Jossey-Bass Inc., 1979.
- Meinert, C.W. and Penney, S. "Credit for Life Experience: Establishing Institutional Policy and Procedures." Journal of Higher Education. 46(May/June, 1975): 339-348.
- Miller, J.W. and Mills, O., eds. Credentialing Educational Accomplishment. Washington, D.C.: American Council on Education, 1978.
- Miller, M.R. Student Handbook on Preparing a Portfolio for the Assessment of Prior Learning. Barre: Vermont State Colleges, Office of External Programs, 1977.
- Murphy, L.R. and Pringle, R.A. Evaluating Non-Traditional Programs: Strategies, Methods, and Materials. Springfield, Illinois: Board of Governors of State Colleges and Universities, 1979.
- Nolan, M.F.; Anderson, L.A.; and Mowrer, J.L. "Faculty Attitude Toward a Nontraditional Studies Program." Alternative Higher Education. 2(Fall, 1977): 17-24.
- Palola, E.G. and Bradley, A.P. Ten Out of Thirty. Saratoga Springs, New York: Empire State College, 1973.
- Palola, E.G. et al. The Methodology of PERC (Program Effectiveness and Related Costs). Saratoga Springs, New York: Empire State College, 1977a. (ED 175 517)
- Palola, E.G. et al. PERC Handbook. Saratoga Springs, New York: Empire State College, 1977b.
- Pendergrass, J.; Stutz, J.P.; and Reilly, R. "The Interview and Related Procedures." Expert Assessment of Experiential Learning - A CAEL Handbook. Edited by R. Reilly et al. Columbia, Maryland: Cooperative Assessment of Experiential Learning, 1977.
- Project on Noncollegiate Sponsored Instruction. A Guide to Educational Programs in Noncollegiate Organizations. Washington, D.C.: American Council on Education and The State University of New York, 1976. (ED 162 546)

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
C. Recap of lesson is conducted during demonstration by instructor.	C. Emphasize safety.	C. Ask questions if material not clear, check notes to insure accuracy and completeness.
V. <u>INFORMAL TEST</u>		
A. There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application".		
VI. <u>ASSIGNMENT</u>		
A. Notetaking Sheet 4-3-1N	A. Provide students with the homework assignment.	A. Ask questions if the assignment is unclear. Complete assignment by reading and studying, 4-1-1N.

1297

0052-53P9

4-3-49

1298



FLEET TRAINING CENTER  
NAVAL STATION  
NORFOLK, VIRGINIA 23511

Miniature/Microminiature Electronic Repair (2M) Program  
A-100-0034

Lesson Topic 4.4:  
Micro-Electronic Circuit Soldering Techniques

Security Classification: UNCLASSIFIED

Time Allocation: Classroom - 2.0 Hours  
Laboratory - 8:75 Hours

INSTRUCTIONAL MATERIALS

1. Training Equipment

- a. MERP/2M Kit

2. Training Aids

- a. Slides

(1) YXP L9-S1 through YXP L9-S31

3. Training Aids Equipment

- a. Projector, Slide  
b. Screen, Projection, Standard

4. Text

- a. Student's Guide

5. References

- a. MIL-STD-454D  
b. MIL-C-47256 (M.I.)

TERMINAL OBJECTIVE

Supported Partially by this lesson topic:

- 6.0 REPLACE component parts on micro-electronic printed circuit boards using the correct tools and soldering techniques and APPLY the proper conformal coating in accordance with the procedures and to the standards outlined in MIL-STD-454D.

ENABLING OBJECTIVES

When you complete this lesson topic, you will be able to:

- 4.4.1 POSITION components on micro-electronic printed circuit boards using the preferred mounting procedures outlined in MIL-STD-454D.  
4.4.2 SHAPE component leads for mounting on micro-electronic printed circuit boards without damaging the leads or components and meeting all bend specifications as listed in MIL-STD-454D.

- \_\_\_\_\_, ed. That's a Very Good Question: The Economic Impact of Credit by Examination. Princeton, New Jersey: Educational Testing Service, 1978. (ED 164 595)
- Whitaker, U.G. "Assessors and Their Qualifications." In M.T. Keeton and Associates Experiential Learning: Rationale, Characteristics and Assessment. San Francisco, California: Jossey-Bass Publishers, 1976.
- Willingham, W. W. and Associates. The CAEL Validation Report. Princeton, New Jersey: Cooperative Assessment of Experiential Learning, 1976.
- Willingham, W.W. Principles of Good Practice in Assessing Experiential Learning. Columbia, Maryland: Cooperative Assessment of Experiential Learning, 1977.
- Woods, J.A. "Costing the Crediting of Life Experiences." Journal of Higher Education. 49(1978): 358-371. (EJ 183 665)
- Yelon, S. and Duley, J. Efficient Evaluation of Individual Performance in Field Placement. East Lansing, Michigan: Michigan State University, 1978.

- 4.4.3 REPLACE electronic components on micro-electronic printed circuit boards utilizing the proper tools and soldering techniques for high quality solder connections following the procedures and to the standards as outlined in MIL-STD-454D.
- 4.4.4 INSPECT micro-electronic printed circuit solder connections on selected boards and DETERMINE that their quality and reliability are in accordance with the standards outlined in MIL-STD-454D.
- 4.4.5 IDENTIFY the proper conformal coating that should be applied to various micro-electronic printed circuit boards. Identification will be in complete agreement with the information contained in MIL-C-47256(M.I.).

#### CRITERION TEST

The student will be required to replace a minimum of at least two each of Dual-in-line, Flat-pack and TO-5 integrated circuits (IC's) on selected micro-electronic single and/or double sided printed circuit boards. The procedures and techniques utilized will be in accordance with those outlined in MIL-STD-454D and to the specifications listed therein.

#### HOMEWORK

Read and study Notetaking Sheet 4-4-1N.

1301

OUTLINE OF INSTRUCTION

1. INTRODUCTION.

A. Contact

B. Readiness

INSTRUCTOR ACTIVITY

A. Introduce self and topic.  
Provide for students needs

1. Muster

2. Comfort

3. Visibility and seating.

B. Explain value of subject  
matter, pointing out  
where appropriate, its  
relationship to the follow-  
ing:

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1. Accomplishment of daily tasks aboard ship.

2. The necessity of the skills and techniques in repair of printed circuit boards.

3. Personal applications of the knowledge and skills.

Seek to motivate. Tell a good tie-in story if possible.

675

1305

OUTLINE OF INSTRUCTION

C. Effect

D. Overview

INSTRUCTOR ACTIVITY

C. When following a subject matter lesson topic, do the following:

1. Explain relationship of this lesson to previous lesson(s).

2. Commend students for mastery of skills in previous lesson(s).

D. Overview lesson by:

1. Stating learning objectives as contained on cover pages to this topic.

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

677

2. Stating procedures to be followed during the lesson.

a. Taking notes.

b. Asking questions.

c. Use of criterion test

3. Invite questions concerning objectives and procedures.

3. Ask questions concerning objectives on procedures if in doubt.

1309

OUTLINE OF INSTRUCTION

II. PRESENTATION

A. Components Preparation

1. Performed leads

a. Many microminiature components today come from the manufacturer with performed leads

b. Preformed leads will greatly ease your job in component preparation but they also require special handling to avoid damaging the lead configuration

2. Specifications and standards

INSTRUCTOR ACTIVITY

A. Display YXP L9-S1.

STUDENT ACTIVITY

A. Take notes, ask questions and observe slides and drawings.

678



### OUTLINE OF INSTRUCTION

a. The specifications and standards for round lead components shall be the same as those learned in previous training

b. The only additions to the specifications apply to flat leads and lap joints. The additions are as follows:

(1) Leads shall contain two distinct bends at an approximate angle of 45 degrees

(2) The lead shall be in contact with the solder pad from the second bend to the lead tip

### INSTRUCTOR ACTIVITY

(1) Display slide YXP L9-S2

(2) Display slide YXP L9-S3

### STUDENT ACTIVITY

679

1313

OUTLINE OF INSTRUCTION

- (3) The contact area of the lead shall not overhand the edge of the solder pad at any point

- (4) The contact area of the lead must be a minimum of  $\frac{1}{2}$  the length of the solder pad

3. Recommended forming tools

- a. There are a large variety of forming tools for multilead components (IC) which are satisfactory for use. Their cost is generally high, however, since a different forming tool must be used for each lead configuration

INSTRUCTOR ACTIVITY

- (3) Display slide YXP L9-54.

- (4) Display slide YXP L9-55.

STUDENT ACTIVITY

1314

1315

089

OUTLINE OF INSTRUCTION

- b. For this reason hand-forming tools are recommended in most cases
  
- c. All those tools and techniques learned in previous training are recommended for use with microminiature components
  
- d. For bending leads of multilead components, the following tools are recommended
  - (1) Smooth jaw needle nose pliers
  
  - (2) Smooth jaw tweezers

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

189

1317

1316

4-4-10

OUTLINE OF INSTRUCTION

4. Hand-forming techniques

- a. All these forming techniques learned in previous training are suitable except for the forming of ribbon leads on the "flat pack" style of multilead components
- b. For bending multilead components use the following techniques
  - (1) Grip the leads with pliers or tweezers with the jaw edge which is nearest the component placed at the point of the first bend

1.318

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

4-4-11

1.319

682

OUTLINE OF INSTRUCTION

(2) Smoothly push the component over to a 45-degree angle with your finger

(3) Grip the leads in the same manner at the point of the second bend

(4) Smoothly push the component in the opposite direction to form the second 45-degree bend

(5) Repeat this action on the opposite side of the component

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

683

1321

### OUTLINE OF INSTRUCTION

#### B. Component Installation

##### 1. Positioning considerations

- a. Whenever possible, the component should be placed symmetrically between the mounting points and have identifying marks visible
- b. The prime rule in repair, however, is to always use the same style and positioning as the original, unless it can be shown that greater reliability can be obtained by changing the positioning

### INSTRUCTOR ACTIVITY

1. Display slide YXP L9-S11.

### STUDENT ACTIVITY

### OUTLINE OF INSTRUCTION

- c. The final positioning consideration which is actually a dictating factor is the actual space provided for the component. This factor is particularly prevalent in micro-electronics where there is often only enough space for the component to be mounted in one way

### 2. Lead terminations

- a. All of the various lead termination styles you have learned in previous training will be found in micro-electronic assemblies
- b. In addition to those you are familiar with, there are some new style terminations which are very common to micro-electronic assemblies

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

585

1325

### OUTLINE OF INSTRUCTION

- c. The first of these is the type used in conjunction with lap-soldered joints
- d. The next type found in some styles of vertical component mounting is called multilead circuit board connections. This is a form of hollow standoff with a solder cup used to connect several leads to the same point
- e. The preferred style of lead termination for through-board solder joints is the straight through termination. This is to allow maximum repairability of the circuits during future maintenance

### 3. Lead cutting

### INSTRUCTOR ACTIVITY

### 3. Display slide YXP L9-S12

### STUDENT ACTIVITY



OUTLINE OF INSTRUCTION

- a. All lead ends must be cut with a flush cutting tool
  - b. Scissors are the most highly recommended tool for cutting flat leads such as those on a flat pack IC, and for cutting the leads on multilead components
- 
- (1) Scissors are ideal for cutting the leads of multilead components since they permit all leads to be cut in a single operation. This will provide a high degree of uniformity in lead length.
  - (2) They are also very good for flat leads since they allow them to be cut with a minimum amount of torque applied to the lead. This is very important since flat leads are easily distorted by very small amounts of torque

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

687

ED193531

CAREER EDUCATION INFUSION:  
A REVIEW OF SELECTED CURRICULUM GUIDES  
FOR THE MIDDLE SCHOOL

written by

Carolyn D. Raymond  
Apache Junction Public Schools  
Apache Junction, Arizona

The ERIC Clearinghouse on Adult, Career, and Vocational Education  
The National Center for Research in Vocational Education  
The Ohio State University  
1960 Kenny Road  
Columbus, Ohio 43210

1980

U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
NATIONAL INSTITUTE OF  
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

CF027 094

OUTLINE OF INSTRUCTION

- c. All other leads may be cut with standard flush cutting pliers

4. Specifications and standards

- a. All component mounting and lead termination specifications previously learned apply to micro-electronic repair
- b. The mounting specifications for IC May be summed up in one statement, mount it the same as the original. This is because the multilead IC packages do not permit any variation in the physical mounting of the component

330

INSTRUCTOR ACTIVITY

4. Display slide YXP L9-S13

4-4-17

STUDENT ACTIVITY

889

1331

## FUNDING INFORMATION

Project Title: ERIC Clearinghouse on Adult, Career, and Vocational Education

Contract Number: NIE-C-400-76-0122

Educational Act  
Under Which the  
Funds were  
Administered: 41 USC 252 (15)  
and PL 92-318

Source of  
Contract: U.S. Department of Education  
National Institute of Education  
Washington, D.C.

Contractor: The National Center for Research in Vocational Education  
The Ohio State University  
Columbus, Ohio

Executive  
Director: Robert E. Taylor

Project Director: Juliet V. Miller

Disclaimer: This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Education. Contractors undertaking such projects under government sponsorship are encouraged to freely express their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official National Institute of Education position or policy.

Discrimination  
Prohibited: Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance."  
Title IX of the Education Amendments of 1972 states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal assistance." The ERIC Clearinghouse project, like every program or activity receiving financial assistance from the U.S. Department of Education, must comply with these laws.



This publication was prepared with funding from the National Institute of Education, U.S. Department of Education, under Contract No. NIE-C-400-76-0122. The opinions expressed in this report do not necessarily reflect the position or policies of NIE or the Department of Education.

OUTLINE OF INSTRUCTION

c. The specifications for a lap-solder joint lead termination is as follows:

(1) The lead must be flush cut, with the cut being perpendicular to the long axis of the lead

(2) No portion of the lead may extend beyond the edge of the mounting pad

d. The specifications for a multiple lead termination will be as follows:

INSTRUCTOR ACTIVITYSTUDENT ACTIVITY

689

1.333

1332

## ABSTRACT

A study is reported which examines the concept of career education infusion as it has been presented in selected curriculum guides, particularly those developed for the middle school and junior high school levels. The report, presented in the form of questions and answers, is written primarily for curriculum developers responsible for planning and implementing career education. It attempts to define the term "infusion" and establish criteria for determining if infusion is being facilitated by the curriculum guides. A second area explored is the relationship between student outcomes in the guides and a comprehensive definition of career education. A third area examined is the concern that implementation of career education at times may not be taking the career development stages of students into account; the report briefly examines the congruence of the outcomes and activities in the guides with appropriate theoretical career development stages. The fourth and final part of the report focuses on whether or not the major instructional components for evaluating the effectiveness of an outcome or activity are included in the guides. (CT)

DESC::\*Career Development; \*Career Education; Curriculum Development; \*Curriculum Guides; \*Junior High Schools; \*Middle Schools; Program Evaluation; Program Development; Definitions; Learning Activities; \*Outcomes of Education

IDEN::Information Analysis

-v-

### OUTLINE OF INSTRUCTION

- (1) All leads must enter the solder cup on a line parallel to the long axis of the solder cup
  - (2) Lead ends shall be bottomed in the solder cup
  - (3) All lead ends shall be cut to a length so that the lead bend, which is nearest to the solder cup, begins not less than one lead diameter above the top edge of the solder cup when the lead is bottomed in the solder cup
- e. On lead termination standard which you have previously been taught is highly important and should be re-emphasized due to its effect on the repairability of micro-electronic assemblies. The standard pertains to straight through terminations

1334

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

069

WHAT WERE THE FINDINGS?	22
HOW CONGRUENT WERE THE GUIDES WITH APPROPRIATE THEORETICAL CAREER DEVELOPMENTAL STAGES?	25
HOW USABLE WERE THE GUIDES FOR ACCOUNTABILITY?	25
WHAT ARE THE IMPLICATIONS?	27
WHAT ARE THE IMPLICATIONS REGARDING THE DEFINITION OF INFUSION?	27
WHAT ARE THE IMPLICATIONS AS THEY RELATE TO CAREER EDUCATION COVERAGE OF COMPREHENSIVE STUDENT OUTCOMES?	29
WHAT ARE THE IMPLICATIONS AS THEY RELATE TO CONGRUENCE OF OUTCOMES TO CAREER DEVELOPMENT THEORY?	29
WHAT ARE THE IMPLICATIONS AS THEY RELATE TO USEFULNESS OF THE GUIDES FOR ACCOUNTABILITY?	30
SUMMARY	31
REFERENCES	32
ADDITIONAL REFERENCES	34
SUGGESTED READINGS	37



### OUTLINE OF INSTRUCTION

- (1) In a straight through termination the lead end must extend a minimum of one lead diameter beyond the board surface and a maximum of two lead diameters.....
- (2) The lead end should never be cut flush with the surface of the circuit board (despite the original design) unless a protruding lead end will cause electrical contact with adjacent assemblies

### C. High-Reliability Micro-Miniature Soldering Techniques

#### 1. Through-board soldering

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

169

1337

The report, presented in the form of questions and answers, has been written primarily for curriculum developers responsible for planning and implementing career education. It also is hoped that teacher educators will use this information to further develop their own "infused" courses of study.

### OUTLINE OF INSTRUCTION

- a. The soldering iron is the most effective tool for making through-board solder joints.
- b. For maximum reliability a through-board solder joint should be completed with 3 seconds after application of heat. This can be accomplished by selecting the proper combination of temperature and tip mass.
- c. A reliable through-board solder joint is formed by using the following techniques
- (1) Thoroughly clean all items which will contact or become part of the solder joint

1338

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

1339

692

courses. Instead, the common recommendation is that they be "infused," "threaded," or "woven" into the content of existing courses in the curriculum. (Hoyt, 1979, p.12)

- . The career development concepts are taught as the present curriculum lends itself to the topic. It is not intended that the normal content should be replaced. Infused career development activities should reflect specific curriculum content which should be mastered by the student as well as a particular career development concept. It is assumed that career development concepts are distributed throughout the K-12 curriculum. The present curriculum concept and career education concept should become so intermeshed or infused that neither is predominate. (Raymond, 1979, p.258)
- . An example often used to communicate "infusion" would be that the subject matter curriculum could be characterized as coffee, the career education concepts as cream, and when the two are mixed they are no longer discernable in their original form. (Partners in Careers, 1977, p.57)

One underlying theme of these definitions is that infusion implies the "weaving in" of career education concepts into the regularly taught curriculum concept. In other words, it "happens" in the instructional content setting. If this is the case, the following criteria could be used to judge whether or not an idea is actually infused:

- . There is a career development concept to be taught - and also a regular curricular concept to be taught
- . The two concepts are woven together in a lesson plan or activity and taught in conjunction with each other or at the same time

An activity idea would not be considered infused if under the following conditions:

- . An added career development-related activity was taught immediately after the regular curricular concept has been taught
- . A separate lesson or amount of instruction related to a career development concept was taught in the regular classroom
- . Another strategy was employed in the classroom environment

OUTLINE OF INSTRUCTION

- (2) Apply liquid flux to the joint area on both sides of the board
- (3) Apply the iron tip to contact both the lead and pad area
- (4) Form a heat bridge with solder
- (5) Apply solder to the connection in sufficient quantity for it to flow through the hole and complete the joint on both sides of the board in a single operation

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

693

increases in pupil academic achievement. If the skills, knowledges, and attitudes to be transmitted through a career education effort were transmitted through addition of a new course, the result would be an "add-on" but not a "refocus" of the system (p. 12).

- . Career development skills, knowledge, and attitudes can, for the most part, be effectively and naturally transmitted to students as part of the regular educational process. Many educators have already been doing this long before the term "career education" was coined. Moreover, if it is an "add-on" curriculum, decisions would need to be made as to what to delete in an already overcrowded curriculum. It simply does not appear to be good logic to think about transmitting career education to students through the mechanism of an entirely new course (p. 12).
- . An "add-on" costs more. The public call is to make education more effective, not to make it more costly. Staff salaries and physical equipment (including classroom space) are the major items involved in any school budget. If, to implement career education, sizable increases in the education budget were to be required, it is highly doubtful if many educational institutions would be either able or inclined to move rapidly. In view of the fact that it does not appear to be essential that the "new course" approach be taken, it would be extremely difficult to justify this approach with those now concerned with the holding down of costs of education (pp. 12-13).

In addition, Hoyt (1979) described the rationale behind infusion in these terms: "Pupils can acquire the skills, knowledge, and attitude career education seeks to convey while simultaneously being motivated to learn and to increase the amount of subject matter actually learned" (p. 23). Hoyt made several extremely important points. He wrote that pupils can -

- . become more aware of the nature of the work of paid employment and simultaneously learn the importance of the basic academic skills for attaining success in the occupational society;
- . explore their interest in possible careers and simultaneously learn why subjects they are taking in school are essential for success in those careers;
- . learn both about the free enterprise system and increase their skills in basic mathematics if the

OUTLINE OF INSTRUCTION

(6) Thoroughly clean the connection after soldering

- d. When soldering multilead components, use a skipping pattern to prevent excessive heat buildup in a single area of the board or component

2. Lap joint soldering

- a. You are familiar with making lap-soldered connections on circuit conductors using a soldering iron. The use of the special lap flow soldering tool and the installation of lap-soldered ICs will be new to you, however

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1342

9289-90P1

4-4-23

1343

694

## WHAT CRITERIA WERE USED TO DETERMINE COVERAGE OF COMPREHENSIVE STUDENT OUTCOMES? (REVIEW FOCUS TWO)

It was decided early in the study that it would be important to determine if the guides were built around career development outcomes and if the coverage of such outcomes was comprehensive or whether it tended toward polarization.

One of the concerns of authorities in this area has been the number of definitions that have persisted. In her study of the definitional and conceptual problems of career education, Hansen (1977) stated that "there are limitations and polarizations in the definitions which need to be attended to if career education is going to continue to be a viable movement in education" (p. 4). In the last few years, other career educators have attempted to pull together a comprehensive definition. Nevertheless, lack of consensus has influenced curriculum development efforts in various ways. What appears to have occurred is the emphasis upon a limited set of student career development outcomes. Hence, it was felt that curricular guides reviewed in this study should be examined for their comprehensiveness and polarization of outcomes.

To determine which outcomes should be utilized as review criteria, it was important to examine several of the more commonly utilized definitions of career education. Hansen (1977) identified several philosophical foci for career education. Some strongly emphasized the economic role and preparation for paid work; some included the economic role but emphasized career development and counseling; others emphasized the several roles for which education is expected to prepare youngsters. Hansen indicated there was a continuum which included -

- . work or the individual;
- . content or process;
- . work roles or multiple roles; and
- . training for employability or educating for life.

Another classification can be made on the basis of how work is defined - that is, whether it is limited to paid employment or whether it includes all significant goal directions activities.

Hansen's philosophical foci may be examined as to whether the emphasis is on one of the following:

- . Job Skills as a Focus for Career Education. This is the most narrow conceptualization and often is equated



OUTLINE OF INSTRUCTION

- b. The following steps should be used to reliably form lap-solder connections

(1) Prior to lap soldering a connection, the solder pads should be cleaned and tinned

(2) Component leads should also be tinned prior to soldering (particularly if they are gold plated).

(3) Properly position the IC and tack solder two opposite corners down to hold the component in place

INSTRUCTOR ACTIVITY

(1) Display slide YXP L9-S14.

(3) Display slide YXP L9-S15.

STUDENT ACTIVITY

695

1:15

1344

Early in the career education movement, through the federally sponsored school-based model, eight elements or student goals were identified. As stated in the Developmental Program Goals for the School Based Model (1972), pp. 6-9, they included the following:

- . Self-awareness - achieving an increased awareness and understanding of interests, aptitudes, and responsibilities as these relate to various careers.
- . Educational awareness - demonstrating increased awareness and understanding of interests, aptitudes, and responsibilities as these relate to various careers.
- . Career awareness - understanding the world of work and its impact on society.
- . Economic awareness - understanding of the economic system both as it relates to career development and the community and society at large.
- . Decision-making - making decisions related to one's career.
- . Beginning competency - understanding the relationship between education and training - appreciating the relationship between what is learned in school and how it is used in work.
- . Employability skills - possessing career entry-level skills upon leaving the formal educational program.
- . Appreciation and attitudes - developing an understanding and appreciation for the value of continual learning, the arts, and leisure qualities of life.

The Office of Career Education (Hoyt, 1975) published an official policy paper which listed nine outcomes that career education seeks to produce in individuals by the time they leave school, at any age or grade level. They are as follows:

- . Competent in basic academic skills required for adaptability in our rapidly changing society
- . Equipped with good work habits
- . Capable of choosing a personally meaningful set of work values that foster in them a desire to work
- . Equipped with career decision-making skills, job hunting, and job getting skills

### OUTLINE OF INSTRUCTION

- (4) Apply liquid flux to all connection points and solder each lead in place. Solder will not normally need to be added if pads are pretinned correctly
- (5) Do not forget to resolder the two tack soldered corner leads after all other leads have been soldered. Remember, also, to skip around when soldering leads so that there is no excessive heat buildup in one area
- (6) After soldering thoroughly, clean all solder connections

### INSTRUCTOR ACTIVITY

- (4) Display slide YXP L9-S16.

### STUDENT ACTIVITY

- . Values of and for others - the student will appreciate both the congruence and the conflicts of personal values and community values that are involved in living in society.
- . Variety of occupations - the student will be familiar with both the diversity and the common characteristics of a variety of occupations.
- . Occupations and the self - the student will be able to evaluate occupations in terms of interest, skills, ability, and self-concept.
- . Aptitudes and training - the student will appreciate the prerequisite abilities of occupations and the training which provides these abilities.
- . Subject relevancy - the student will recognize the contribution of formal education to the world of occupations.
- . The value of work - the student will know the various meanings described to work and the satisfactions that can be derived from work.
- . The discipline of work - the student will recognize the importance of individual responsibility in any work situation.
- . Acceptance of all workers - the student will understand that all occupations and all workers make valuable contributions to society.
- . Interdependence of workers - the student will appreciate the ways in which workers depend upon each other while functioning in the world of work.
- . Planning and acceptance - the student will be able to make feasible career plans and prepare for a variety of planning outcomes.
- . Lifestyle and value of success - the student will appreciate the varieties of life styles and the measures of success associated with careers and experienced by workers.
- . Societal and economic causes and effects - the student will understand the mutual interaction of occupations with society and the economic world, and will appreciate

697

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>c. Lap-soldered clearance hole connections such as those shown in this slide may also be made with the lap flow soldering tool. NOTE the excessive solder quantity on connections</p>	<p>c. Display slide YXP L9-S17.</p>	
<p>3. Soldering multiple lead joints</p> <p>a. Multiple lead connections are soldered with the same techniques as those used on connector pins</p> <p>b. Great care must be taken when soldering this type of connection to prevent head damage since it has a relatively large mass which requires considerable heat in solder</p>		

1349

## HOW CONGRUENT WERE THE GUIDES WITH THE THEORY OF CAREER DEVELOPMENTAL STAGES? (REVIEW FOCUS THREE)

One of the many concerns advocates of career education have is that implementation in schools is not considering the theoretical underpinnings of a person's career development. Most development, it has been stated, has been of the "hit and miss" approach regarding what is being taught at various developmental levels. Herr (1977) discussed this at some length:

There is little direct evidence that career education programs are being developed from specific theoretical models or concepts. An initial category of concern to this paper was the relationship of career development theory to career education. However, no research or evaluation studies were found which pursued such relationships directly. There are many studies available which test specific hypotheses generated by different theoretical approaches, but these studies typically do not address career education in either the procedures or the findings. It seems apparent that many current career education projects have borrowed their goals from national or state demonstrations projects which themselves may have officially used career development theory of some description (Holland, Super, Tiedeman, Roe) for conceptual frame reference. Unfortunately, the original linkage between career development theory and national or state model goals have tended to become obscure as the goals have taken on their own legitimacy in the uses of those who borrow the goals indiscriminantly. In some other instances, career education projects tend to be theoretical, focusing on means rather than either goals or outcomes (p. 62).

Hansen (1977) also stated that -

The expanded career education concept builds on a solid rationale and conceptual framework of the best knowledge available in career development theory and research. This means that programs are based on what is known about occupational socialization process, career needs of youth and adults, stereotyping and information processing, developmental tasks at different life stages, and career decision-making processes (p.36).

WHAT ARE THE APPROPRIATE  
CAREER DEVELOPMENTAL TASKS  
FOR MIDDLE SCHOOL STUDENTS?

### OUTLINE OF INSTRUCTION

- c. It is highly recommended that heat shunts be used when soldering this type of connection

### D. Use and Capabilities of Soldering Tools

#### 1. Soldering iron

- a. The soldering iron has the capability of soldering any type of soldered connection as you have learned
- b. It is only necessary to learn to select the proper tip and temperature setting to gain this versatility

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

1351

869

method for acquiring the discipline of work.

- Identification with the concepts of work as a valued institution - at this stage, children move to identification with the concepts of work as they develop the ability to conceptualize. Once they have internalized this value, they proceed to personalize it.
- Increasing knowledge about workers - students should expand their knowledge of workers beyond the home and neighborhood. Emphasis should be on having students actively encounter the world of work with its accompanying terminology and concepts. The most effective way for this to occur is through direct contact with workers.
- Increasing interpersonal skills - peer relationships are important, and an increasing amount of sophistication is required at this level. Students must now work effectively in more complex types of group activities.
- Increasing objectification of self before others - the more competent individuals become during this stage, the more likely they will be able to overcome future problems of adolescence and maintain their self-esteem.
- Valuing human dignity - youngsters move from respect for specific people and their work to appreciation of all people. Students need to gain understanding of the interdependence of all people (pp. 29-31).

#### Junior High School Stage.

At this point in children's development, individuals undergo great changes physically, intellectually, and socially. They must come to accept themselves as an entirely different person both outwardly and inwardly. The concern during this period is with identity (p. 31).

- Clarification of self-concept - self-concepts begin to form prior to adolescence but are made clear through this period in terms of "new" self. The individual is in an exploratory stage of vocational development and explores self-attributes and dimensions of the world of work.
- Assumption of responsibility for vocational planning - for the first time students usually have a choice in some of their curriculum. They combine a sense of agency with the discipline of work; they assume responsibility and a sense of independence.



### OUTLINE OF INSTRUCTION

- c. Although capable, the soldering iron is not always the easiest and most efficient soldering tool to use. Some special application soldering tools will be discussed next

### 2. Lap flow soldering tool

- a. The tool may solder anything from a standard flat lead to a single small strand of wire.
- b. The proper use of the lap flow tool in making a lap-soldered connection is as follows:

### INSTRUCTOR ACTIVITY

- a. Display slide YXP L9-S18.

### STUDENT ACTIVITY

699

1353

## HOW USABLE ARE THE GUIDES FOR ACCOUNTABILITY PURPOSES? (REVIEW FOCUS FOUR)

In the implementation of new efforts, educators must look for ideas, programs, and materials that will allow them to be accountable for results. Program implementors need to evaluate the effectiveness of what they are attempting to achieve - as well as to make programmatic changes enroute. Along these lines, Herr (1977) wrote that "Many evaluation reports tend to be descriptive of the types and amount of participation by teachers and students in career education efforts without assessing the quality of this participation or the relationship of certain types of career education participation to subsequent outcomes, for example, student learning" (p. 62). He concluded that much more needs to be done to answer the major question - namely, does career education make a difference in student learning?

Several components should be present in curriculum guides that will allow one to evaluate effectiveness of the activities and be accountable from a program perspective. The writer did not attempt to identify all the components of a "good" guide but rather examined the guides for at least three major instructional components. The following components from the instrument, "Assessment Tool for Determining a 'Good' Curriculum Development Product," (Raymond, 1972) were considered: instructional objectives, which are measurable or observable; assessment tools, which could be used both in a pre- and post-assessment; and activities congruent to instructional objectives.

### WHAT CRITERIA WERE USED TO DETERMINE POTENTIAL FOR ACCOUNTABILITY?

Three criteria, presented below as a rating scale, were used to determine usefulness of the guides for potential accountability:

Adequate	Somewhat Adequate	Missing	
2	1	0	(1) Are there written, measurable student instructional objectives?
2	1	0	(2) Are there ways of measuring student achievement of each objective? Are measurement tools congruent with objectives?

### OUTLINE OF INSTRUCTION

- (1) Set the temperature of the lap flow tool (using a practice board) so that the solder on the connection will completely melt in less than 3 seconds
- (2) Apply the tip of the tool to the connection to be soldered, using the tip to hold the lead in the proper position
- (3) Depress and hold the footswitch until the solder has melted and flowed over the connection. (Add a small quantity of solder if needed)

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

1.355

700

From this data, the following points should be highlighted:

- . Only 19.7 percent of the documents appeared to use an infusion approach.
- . Of those that did not use an infusion approach, the guides tended to focus on two areas - career occupational information and/or self-awareness concepts. Materials included such things as career cluster exploration units for junior high students, work/study courses, career guidance units, and stand-alone career education instructional units.
- . The courses that included simulations (14 percent) usually used application type exercises of a practical nature.
- . Several (6.5 percent) of the documents were vocational skill instructional materials.
- . Documents in the "other" category included such things as "how to" guides in planning, implementing, and evaluating career education efforts as well as several final project reports.
- . If we eliminate the fifty-two documents that were not curriculum guides, we find that seventy-three of the remaining documents (22.9 percent) were career education guides that might be using an infusion approach.

Of the seventy-three documents that appeared to use an infusion approach, sixty-three (or 86.3 percent) were obtained and reviewed. Two were annotated bibliographies; seven were eliminated because they were specifically designed around regular courses in which no career development concepts occurred. The remaining fifty-four guides were reviewed using the criteria in the four review focus areas.

#### WHAT APPROACH WAS USED TO ANALYZE THE GUIDES?

A reviewer's checklist for examining the curriculum guides (see appendix) was developed. Their checklist allowed the writer to analyze the fifty-four documents according to the following main questions:

- . Was an infusion approach actually used as defined in this document?

### OUTLINE OF INSTRUCTION

- (4) Keeping the tip in place, release the footswitch and allow the solder to solidify. The lap flow tip is a rapid cooling, non-solderable metal which will not stick to, or damage, the connection.

- c. The tip of the lap flow tool is spring-loaded to prevent excessive pressure from being applied to the joint during soldering

### 3. Hot air jet soldering

- a. It is also possible to perform soldering with the hot air jet on very small connections and on lap soldered joints

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

106

1357

## WHAT WERE THE FINDINGS?

The next several pages describe the findings of the review and analysis on the four focus areas.

### HOW WELL DID THE GUIDES COVER A COMPREHENSIVE SET OF OUTCOMES?

#### Coverage of the Eighteen Career Development Outcomes.

Using the eighteen career developmental outcomes of the Mesa project, the area of occupational information did have a high area of emphasis - a 30 percent level. The subject relevancy outcome included both a description of how what is learned in school is used in work settings and application exercises on regular curricular topics. The following chart indicated the percentages of outcome coverage by the eighteen career developmental goals:

<u>Goal Outcomes</u>	<u>Percent of Coverage</u>
Variety of Occupations	30.0
Value of Work	14.2
Variety in Self	11.1
Values of and for Others	6.5
Societal and Economic Causes and Effects	6.0
Decision Making	4.2
Interpersonal Skills	4.2
Subject Relevancy	3.7
Lifestyle and Value of Success	2.8
Occupations and Self	2.3
Aptitudes and Training	2.3
Planning and Acceptance	2.3
Interdependence of Workers	1.4
Effects of Self	1.0
Discipline of Work	1.0

### OUTLINE OF INSTRUCTION

- b. The method is exactly the same as for desoldering with the hot air jet except that the lead is pressed into the solder when it melts rather than lifted out of the solder
  
- c. This method is only recommended for use when the connection to be soldered is known to be highly susceptible to damage from contact pressure during soldering

### E. Solder Joint Inspection

#### 1. Acceptance standards

### INSTRUCTOR ACTIVITY

### STUDENT ACTIVITY

Some of the major highlights are as follows:

- . If equal coverage was considered important, each goal would average 17 percent. The only goal close to that average was basic academic skill competence.
- . Career decision making and employment seeking skills were highest, with 35 percent coverage, followed closely by incorporation of work values into personal value (21.8 percent).
- . All other goals were poorly covered, thereby indicating polarization of a few goals.

Coverage of the Eight School-Based Themes/Outcomes.

The following chart indicates the percentages of outcome coverage using the eight themes/elements of the school-based model:

<u>Outcome</u>	<u>Percent of Coverage</u>
Career Awareness	43.0
Self-Awareness	12.9
Employability Skills	11.5
Beginning Competency	9.5
Educational Awareness	7.4
Appreciation and Attitudes	6.5
Economic Awareness	6.0
<u>Decision Making</u>	<u>4.2</u>

Some of the major highlights are as follows:

- . Once again, the highest outcome coverage is in the area of career awareness which was mainly a focus on occupational information.
- . Average goal coverage should have been 12.5 percent; only the self-awareness and employability skills areas approached this.
- . Economic awareness did not come out high on polarization.



OUTLINE OF INSTRUCTION

a. You have previously learned the acceptance criteria for all types of printed circuit solder joints except for the lap-soldered connection

b. The acceptance standards for lap-soldered connections is as follows

(1) The outline of the component lead must be plainly visible through the solder

(2) The solder must thoroughly cover the pad area, lead surface, lead end, and lead edges.

INSTRUCTOR ACTIVITY

(1) Display slide YXP L9-S19.

STUDENT ACTIVITY

703

1361

Some of the major highlights are as follows:

- . The range of points was from 0 to 4. One-third of the guides were totally unacceptable for accountability purposes, having received zero points.
- . Only one-fourth of the guides were useful for accountability purposes.
- . The average percentage of all guides of potential accountability usefulness was 31.8 percent. (The desired average percent would have been 66.7 percent.)

In short, the quality of the guides from an accountability point of view was disappointing.

OUTLINE OF INSTRUCTION

- (3) A smooth concave fillet must be formed from the pad to the lead end, lead edges, and the underside or heel of the lead bend

NOTE: The fillet at the heel of the lead bend provides the majority of the solder connections strength

- (4) A smooth gleaming surface finish free of any defects with two exceptions

- (a) A depression in the surface of the solder on top of the lead is permissible if the lap flow tool was used to make the connection

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

- . Infused - in a science lesson requiring scientific inquiry (identification of problem, formulation of hypothesis, gathering information, testing effects of results on each hypothesis, drawing conclusions), students discuss the differences between personal and scientific problems. They discuss the probability factors involved when predicting how people might act as opposed to how objects will act (Bread and Butterflies, 1974, p. 41).
- . Change in Classroom Environment - students learn decision-making skills when allowed to select which approach to use in learning a science concept. Students can select a group activity, filmstrip kit, or self-instructional book.
- . Add-On Unit - the teacher sets aside fifteen minutes of six science periods to teach a unit on decision making.

All of these are suitable ideas, but unfortunately they tend to confuse the teacher who is asked to write infusion activities. It is, therefore, strongly recommended that distinctions be made among the following strategies:

- . Items infused into the regular curriculum
- . Changes in the classroom environment
- . Add-on units of instruction
- . Add-on courses of instruction
- . Integration into other school programs (e.g., activities of counselors, school nurses, and the like).

The idea is that "infusion" (to be least confusing) is used best when it is restricted to the curriculum content of instruction. If this is the case, the following criteria are used to judge whether an activity is infused or not:

- . There is a career development concept to be taught
- . There is a regular curriculum concept to be taught
- . The two concepts are woven together in a lesson plan and taught in conjunction with each other or at the same time.

The career development concept can be taught as a motivator, in conjunction with, as a part of direct practice, or as a culminating activity with the regular curriculum content.

OUTLINE OF INSTRUCTION

- (b) Small frosty areas on the surface of the solder are permissible if the lead was gold-plated

2. Rejection standards

- a. The rejection criteria for all connections except lap-soldered joints is the same as those you have learned in previous training
- b. The rejection standards for lap-soldered connections are as follows:

INSTRUCTOR ACTIVITY

- a. Display slide YXP L9-S20.

STUDENT ACTIVITY

705

1385

1384

account for some of the nonsignificant data being found when comparing various career education effects. Outcomes must be designated by developmental level if we expect to meet the needs of students at the most appropriate time. These findings give rise to the fact that we may not be setting high enough expectations for students.

WHAT ARE THE IMPLICATIONS  
AS THEY RELATE TO USEFULNESS  
OF THE GUIDES FOR ACCOUNTABILITY?

As the data indicated, the majority of the guides were not useful from an accountability point of view. It is recommended that future funding of projects (whether at the national or state level) identify specific instructional components that must be included in any curriculum developmental efforts. We must begin to show evidence that career education really works. One way to do this is to ensure that materials developed have the potential to be used for accountability.

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>(1) Insufficient solder which occurs when the concave fillets fall below a line drawn from the pad surface to the top edge of the lead at a 45-degree angle</p> <p>(2) Excessive solder which occurs if the outline of the component lead is not clearly visible, and if any fillets are not concave</p> <p>(3) Solder spillage over the edge of the solder pad</p> <p>(4) No fillet on the heel of the lead bend</p>		

1367

706

## REFERENCES

- Bridgeford, N. et al. Directions in Career Education: Questions People Ask about Education and Work. Portland, Oregon: Northwest Regional Educational Laboratory, 1977. (ED154160)
- Developmental Program Goals: Comprehensive Career Education Model. Columbus: The Ohio State University, The National Center for Research in Vocational Education, 1972.
- Hansen, L.S. An Examination of the Definitions and Concepts of Career Education. Washington, D.C.: National Advisory Council for Career Education, Superintendent of Documents, U.S. Government Printing Office, 1977. (ED141609)
- Herr, E.L. Research in Career Education. Columbus: The Ohio State University, ERIC Clearinghouse for Adult, Career, and Vocational Education, 1977. (ED149177)
- Hoyt, K.B. An Introduction to Career Education. Washington, D.C.: U.S. Office of Education, U.S. Government Printing Office, 1975.
- \_\_\_\_\_. Notes taken by Carolyn Raymond at presentation for an AASAI-NSBA Career Seminar, Phoenix, Arizona, 1976.
- \_\_\_\_\_. A Primer for Career Education. Washington, D.C.: U.S. Office of Education, U.S. Government Printing Office, 1979. (ED145252)
- \_\_\_\_\_. Refining the Career Education Concept, Part III. Washington, D.C.: U.S. Office of Education, U.S. Government Printing Office, 1978. (ED164860)
- Partners in Careers. Career Education Workshop, Teacher's Guide. Arlington, Texas, 1977.
- Popper, W. and McClain, T. Career Education Infusion: Strategies for the Classroom. Amherst: University of Massachusetts, Institute for Governmental Services, 1978. (ED159481)
- Preli, B. Career Education and the Learning Process. Washington, D.C.: U.S. Government Printing Office, 1978.
- Raymond, C. 1978 Annual Career Education Handbook for Trainees. Tempe, Arizona: Palo Verde Associates, 1978.
- \_\_\_\_\_. 1979 Annual Career Education Handbook for Trainees. Tempe, Arizona: Palo Verde Associates, 1979.



OUTLINE OF INSTRUCTION

- (5) Dewetted areas on any part of the lead or solder pad
- (6) Excessive frosty appearance of the solder surface on a gold plated lead. This indicates that enough gold is present in the joint to seriously detract from its strength
- (7) Any evidence of internal solder bonding defects such as pits, cracks, roughness, etc.
- (8) The connection is also unacceptable if the lead bends or positioning is incorrect

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

707

1369

## ADDITIONAL REFERENCES

- Aanenson, G. et al. Home Life Skills: Career Related Junior High Home Economics Courseguide. St. Paul: Minnesota State Department of Education, Pupil Personnel Services Section; Roseville, Minnesota: Roseville Area School District, 1977. (ED 153 026)
- Anderson, P. et al. Career Development Curriculum for English Teachers. Minneapolis: University of Minnesota, College of Education, 1974. (ED 144 069)
- Benton, J. et al. Lessons in Career Education for Use in Geometry, Career Exploration 9-10, Revised. Cincinnati, Ohio: Cincinnati Public Schools, 1976. (ED 151 594)
- Blades, B. et al. A Model Delivery System for an Exploratory Career Education Program. Grades (5-9). Seaford, Delaware: Seaford School District, n.d. (ED 113 505)
- Borhani, R. et al., comp. Kansas Administrators and Teachers Curriculum Plans for Secondary Career Education Infusion. Hutchinson, Kansas: Hutchinson Community Junior College, 1977. (ED 145 171)
- Bowman, J. et al. Getting Started: A Guide to Writing Your Own Curriculum. The Pennsylvania Guide for Instructional Improvement through Career Education. Elementary Volume K-6. Lewisburg, Pennsylvania: Central Susquehanna Intermediate Unit 16, 1976. (ED 141 500)
- \_\_\_\_\_. Getting Started. A Guide to Writing Your Own Curriculum. The Pennsylvania Guide for Instructional Improvement through Career Education. Junior High Volume 7-9. Lewisburg, Pennsylvania: Central Susquehanna Intermediate Unit 16, 1976. (ED 141 499)
- Burkhart, P. Planning for Career Education Grades 7-9. Pocatello, Idaho: Pocatello School District 25, n.d. (ED 136 061)
- Curtis, A. et al. Career Education in Art: A Junior High Course Guide. St. Paul: Minnesota State Department of Education, Pupil Personnel Services Section; Roseville, Minnesota: Roseville Area School District 623, 1977. (ED 153 023)
- Elmore, M.E. et al. K-12 Urban Career Education Learning Modules: 7-12 Language Arts/Social Studies. Dallas, Texas: Dallas Independent School District, 1977. (ED 159 445)

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>3. Visual indications</p> <p>a. All of the defects described may be detected visually by the indications described in this lesson and those taught to you in previous training</p> <p>b. When visually inspecting micro-miniature solder connections it may often be necessary to use the microscope to reliably check for defects due to the small size of the connection</p> <p>c. The following slides will show some defective lap soldered connections</p>		

- a. All of the defects described may be detected visually by the indications described in this lesson and those taught to you in previous training
- b. When visually inspecting micro-miniature solder connections it may often be necessary to use the microscope to reliably check for defects due to the small size of the connection
- c. The following slides will show some defective lap soldered connections

1371 208

- Lewis, J. et al. Interdisciplinary Guide to Career Exploration.  
Vale, Oregon: Vale School District 15, 1975. (ED 138 800)
- McGowan, R.J. and Mongerson, M.D., ed. Career Education Competencies: A Catalog for Teacher Educators. Buffalo: State University of New York, n.d. (ED 130 064)
- Nickel, L. et al. K-12 Urban Career Education Learning Modules: 7-12 Electives. Dallas, Texas: Dallas Independent School District, 1977. (ED 159 447)
- Peterson, M. et al. Career Education Guide: (3-4). Charleston: Eastern Illinois University, Center for Educational Studies, 1975. (ED 130 009)
- \_\_\_\_\_. Career Education Guide (5-6). Charleston: Eastern Illinois University, Center for Educational Studies, 1975. (ED 130 010)
- Popper, W. and McClain, T. Career Education Infusion: Strategies for the Classroom. Amherst: University of Massachusetts, Institute for Governmental Services, 1978. (ED 159 481)
- Procek, J. et al. Career Education Programs: Grades 7 and 8. Pulaski, Wisconsin: Pulaski School District, 1975. (ED 116 004)
- Ryan, C W. et al. Career Education in Higher Education (An Infusion Model) Volume II. Orono: University of Maine, College of Education, 1978. (ED 166 365)
- Strain, M.P. and Beringer, R. Teaching Career Education in Social Studies, Grades 10-12. World Culture Ancient and Medieval History, Modern History. Resource Manual No. 314. Cincinnati, Ohio: Cincinnati Public Schools, Department of Curriculum and Instruction, 1977. (ED 153 000)

### OUTLINE OF INSTRUCTION

- (1) The module in this slide was repaired by an untrained technician. Note the left IC of the center row



- (2) As this close up view of the IC, which was replaced, shows nearly any defect possible may be found in these connections

- (3) Another example of repairs attempted by untrained personnel. Note the IC at the bottom right corner.

- (4) This slide clearly speaks for itself (or perhaps the proper word is shouts) as to the quality of the lap-soldered connections

### INSTRUCTOR ACTIVITY

- (1) Display slide YXP L9-S21,

- (2) Display slide YXP L9-S22.

- (3) Display slide YXP L9-S23.

- (4) Display slide YXP L9-S24.

### STUDENT ACTIVITY

606

1373

- Lorain City Schools. Career Education Orientation and Exploration Curriculum Guide (7-10) and Supplement. Lorain, Ohio, 1973. (ED 101 198)
- Louisiana State Department of Education. Career Education Guide for Earth Science 7-9. Baton Rouge, Louisiana, 1974. (ED 117 568)
- Mid Hudson Career Development and Information Center. Vocational Development in Grades Seven, Eight, and Nine. Beacon, New York; Albany: New York State Department of Labor, Mid Hudson Industrial Association; Albany: New York State Education Department, Division of Employment, n.d. (ED 065 666)
- Minnesota Environment Sciences Foundation, Inc. Career Development: The Family - Home - Community Project: Community Guide. Minneapolis, Minnesota; Robbinsdale, Minnesota: Robbinsdale Independent School District 281, 1974. (ED 103 591)
- Missouri State Department of Education. Career Development Guide: Grades 6-8. Jefferson City, Missouri: Research Coordinating Unit; Montgomery City, Missouri: Montgomery County R-2 Public Schools, 1973. (ED 106 636)
- Newark School District. Career Education Resource Units: Grade 4. Newark, Delaware, 1976. (ED 142 780)
- \_\_\_\_\_. Career Education Resources Unit: Grade 5. Newark, Delaware, 1976. (ED 142 781)
- \_\_\_\_\_. Career Education Resource Units: Middle School Vol. 1. Newark, Delaware, 1976. (ED 142 783)
- Oregon City School District. Proposal to Assist Oregon City School District No. 62 to Plan and Implement a SUTOE Program in an Existing Curriculum: Final Report. Oregon City, Oregon, 1974. (ED 118 954)
- Petersburg Public Schools. Research and Development Project in Career Education. Curriculum Resource Guide Volume II - Grades 5-8. Petersburg, Virginia, 1974. (ED 130 135)
- \_\_\_\_\_. Research and Development Project in Career Education. Curriculum Resource Guide. Volume III - Grades 8-9. Petersburg, Virginia, 1974. (ED 130 136)
- Radford City Schools. Elementary Career Education Units: Grades 6 and 7. Radford, Virginia, n.d. (ED 107 891)

OUTLINE OF INSTRUCTION

F. Applying Conformal Coatings

1. Surface preparation

- a. There are several thousand different coatings on the market today, and it is totally impractical to try and teach you the proper surface preparation for each type
- b. The proper requirements for cleaning and preparation are provided with each coating and if followed explicitly will give reliable results

1374

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

1375

710

- \_\_\_\_\_. Mason County Career Education, K-Adult Vol. II. Teacher's Instructional Manual for Upper Elementary Education 4-6. Charleston, West Virginia, n.d. (ED 143 819)
- \_\_\_\_\_. Mason County Career Education, K-Adult Vol. III. Teacher's Instructional Manual for Secondary Education, 7-12. Charleston, West Virginia, n.d. (ED 143 820)
- Wichita Public Schools. Career Education Activity Kit, 5-6. Wichita, Kansas, 1974. (ED 118 963)



OUTLINE OF INSTRUCTION

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

2. Application techniques

- a. Coatings may be either sprayed, poured, or brushed on
- b. The type of coating, the desired thickness, and the size of the area to be coated will determine which method should be used
- c. When applying coatings always follow these basic rules
  - (1) Never apply the coating thicker than the original

711

OUTLINE OF INSTRUCTION

(2) Never apply a coating of a different type from the original

(3) Always apply carefully so that there are no bubbles or uncoated spaces in the coating

3. Curing methods

- a. As with preparation methods, there are a multitude of curing methods and it is best to follow the curing directions provided with each coating

1378

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

4-4-41

1379

712

### OUTLINE OF INSTRUCTION

- b. The curing time of nearly all coatings may be speeded up by heat, however, remember that the recommended curing temperature of a coating must NEVER be exceeded and that a module should not be released from the repair shop until the coating has cured completely.

### G. Safety Precautions

#### 1. Workpiece

- a. Follow proper workpiece handling procedure at all times

1380

### INSTRUCTOR ACTIVITY

- G. Display slide YXP L9-S31.

4-4-42

### STUDENT ACTIVITY

713

1381

OUTLINE OF INSTRUCTION

b. Never perform an action which will degrade or damage the workpiece

c. Perform all work to the best of your capabilities

2. Tool

a. Properly maintain and handle all tools

b. Use all tools ONLY for their intended purpose

INSTRUCTOR ACTIVITY

STUDENT ACTIVITY

OUTLINE OF INSTRUCTION	INSTRUCTOR ACTIVITY	STUDENT ACTIVITY
<p>3. Personal</p> <p>a. Exercise the proper safety precautions for all of the following potentially dangerous items which you will be working with</p> <p>(1) Electrically powered tools</p> <p>(2) Edged tools</p> <p>(3) Rotating tools</p> <p>1384</p>		<p>715</p> <p>1385</p>

OUTLINE OF INSTRUCTION

(4) Hot tools

(5) Caustic, toxic, and flammable chemicals and materials

H. Demonstration

1. Micro-electronic soldering of IC's

1386

INSTRUCTOR ACTIVITY

1. Instructor should demonstrate the proper techniques and use of tools while showing the students how to install micro-electronic components (IC's) on single and double sided circuit boards as covered during the lesson.

4-4-45

STUDENT ACTIVITY

1. Observe and ask questions if necessary.

1387

9/6

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
<p>III. <u>APPLICATION</u></p>		<p>717</p>
<p>Performance Sheet 4-4-1P</p>	<p>Supervise each student's completion of 4.4.1P, emphasizing safety</p>	<p>Complete 4-4-1P. Ask questions if procedures are not clear.</p>
<p>IV. <u>SUMMARY</u></p>		
<p>A. Introduction</p>	<p>A. Emphasize importance of the summary for the student.</p>	
<p>1. Nature of summary.</p>		
<p>2. Purpose of summary.</p>		
<p>1388</p>		<p>1389</p>

<u>OUTLINE OF INSTRUCTION</u>	<u>INSTRUCTOR ACTIVITY</u>	<u>STUDENT ACTIVITY</u>
B. Directions to students.		
1. Questions		
2. Notes		
C. Recap of lesson. Completed during demonstration.	C. Emphasize safety	C. Ask questions if material not clear; check notes to insure accuracy and completeness.
V. <u>INFORMAL TEST</u> There is no informal test for this lesson topic. It has been provided for through the implementation of Part III, "Application."		



OUTLINE OF INSTRUCTION

VI. ASSIGNMENT

Read and study 4.4.1N in student guide.

INSTRUCTOR ACTIVITY

Provide students with the home-work assignment.

STUDENT ACTIVITY

Ask questions if the assignment is unclear.  
Complete assignment.

7/9

1392

1393

STUDENT'S GUIDE  
FOR  
MINIATURE/MICROMINIATURE ELECTRONIC REPAIR (2M) PROGRAM

PREPARED BY  
FLEET TRAINING CENTER  
NORFOLK, VIRGINIA 23511

A-100-0034

PREPARED FOR  
CHIEF OF NAVAL TECHNICAL TRAINING

MARCH 1977

1394

## FRONT MATTER

	PAGE
Table of Contents - - - - -	v
How to Use This Guide - - - - -	vii
Instruction Sheets - - - - -	vii
Related Materials - - - - -	vii

## OUTLINE OF INSTRUCTION

1-2-1A	Introduction to the Course - - - - -	2
1-2-1N	Introduction to the Course - - - - -	3
1-3-1A	Introduction to High Reliability Soldering - - - - -	7
1-3-1N	Introduction to High Reliability Soldering - - - - -	8 8
1-4-1A	Preventive Maintenance of the 2M Repair Station - - - - -	23
1-4-1N	Preventive Maintenance of the 2M Repair Station - - - - -	24
2-1-1A	Printed Circuit Board Component Installation and Soldering - - - - -	25
2-1-1N	Installation and Soldering of Printed Circuit Components - - - - -	26
2-2-1A	Conformal Coating Removal - - - - -	39
2-2-1N	Conformal Coating Removal - - - - -	40
2-2-1I	Conformal Coating Removal - - - - -	46
2-3-1A	Desoldering Printed Circuit Board Components - - - - -	49
2-3-1N	Desoldering and Removing Components - - - - -	50
2-4-1A	Repair of Damaged Printed Circuit Boards - - - - -	63
2-4-1N	Repair of Damaged Circuit Boards - - - - -	64
3-1-1A	Soldering to Turret Terminals - - - - -	74
3-1-1N	Hand Soldering Turret Terminals - - - - -	75
3-1-1I	Electrical Wire Splicing - - - - -	85
3-2-1A	Soldering to Hook and Pierced Tab Terminals - - - - -	88
3-2-1N	Hand Soldering Hook and Pierced Tab Terminals - - - - -	89
3-3-1A	Soldering to Bifurcated Terminals - - - - -	95
3-3-1N	Hand Soldering Bifurcated Terminals - - - - -	96
3-4-1A	Soldering Connector Pins - - - - -	106
3-4-1N	Solderable Connector Pins - - - - -	107
4-1-1A	Introduction to Micro-Electronic Circuit Boards - - - - -	115
4-1-1N	Introduction to Micro-Electronic Circuit Soldering - - - - -	116
4-1-1I	Publications for use in Miniature/Micro-miniature Repair - - - - -	119
4-2-1A	Microminiature Repair Task Identification and Procedural Analysis - - - - -	121
4-2-1N	Micro-Miniature Repair Task Identification - - - - -	122
4-3-1A	Micro-electronic Circuit Conformal Coating Removal and Desoldering Techniques - - - - -	130
4-3-1N	Micro-Electronic Circuit Conformal Coating Removal and Desoldering Techniques - - - - -	131
4-4-1A	Micro-Electronic Circuit Soldering Techniques - - - - -	140
4-4-1N	Micro-Electronic Circuit Soldering Techniques - - - - -	141

Note: Lesson 1-1-1A and parts of the front matter have been omitted because of military specific materials.

## HOW TO USE THIS GUIDE

This Student's Guide, which is your personal copy, has been prepared to assist you in your study of the Miniature/Microminiature Electronic Repair (2M) Program as presented in Course A-100-0034. Its primary purposes are:

1. to provide the material required during the course that will promote optimum development of your technical competence, as it applies to technical knowledge, maintenance tools and maintenance routines.
2. to provide sufficient reference material that will enable effective use of the appropriate specifications and publications.
3. to provide self-help materials.

## INSTRUCTION SHEETS

**Assignment Sheets** - These sheets are provided for all topics. They contain outside reading and/or written work when it is considered necessary. The assignment sheet contains the objectives for the topics. They can become an effective "learning tool" if you apply yourself diligently in completing the assignments. Included on these sheets are thought-provoking questions covering the major points of the assignment.

**Notetaking Sheets** - These sheets are provided for most topics. In addition to preprinted matter in outline form, the notetaking sheets contain ample blank space for personal notes. Properly completed, they can be very useful for review of the topic at a later date.

**Job Sheets** - These sheets are provided for topics which require you to perform a physical skill such as operating the equipment. These sheets contain step-by-step instructions, or references to the appropriate manual, to guide you in performing the job.

## RELATED MATERIALS

MIL-STD-4540, Electronic Equipment  
 MIL-S-45743C, Soldering Manual Type, High Reliability, Electrical,  
 Electronic Instrument, Communication and Radar for Radar  
 and Aerospace and Control System  
 NHB 5300.4(3A), Requirement for Soldering Electrical Connections  
 MIL-STD-275C, Printed Wiring for Electronic Equipment  
 The Pace Rework and Repair (R&R) Technology Series Volumes 1, 2, 3, 4,  
 5, 6, 7 and 8 dated 1971

## ASSIGNMENT SHEET 1-2-1A

TITLE

Introduction to the Course

OBJECTIVE

When you complete this lesson topic, you will be able to:

- 1.2.1 COMPLY with classroom procedures, regulations, schedules, scholastic requirements and special instructional activities in accordance with information outlined in the Student's Guide.

STUDY ASSIGNMENT

Read and study Notetaking Sheet 1-2-1N of the Student's Guide.

STUDY QUESTIONS

None

## NOTETAKING SHEET 1-2-1N

TITLE

Introduction to the Course

REFERENCESNOTETAKING OUTLINE

## A. Purpose of the course

1. To provide maintenance personnel with the latest methods to disassemble, repair and solder miniature printed circuits, components, terminals, solderable connectors, circuit board laminates and conductors to replace electronic components on microminiature single and double sided printed circuit boards and the proper preventive maintenance procedures for the repair station and its associated components.

## B. Course Objectives

1. REPLACE component parts on printed circuit boards using the correct tools and soldering techniques and apply the proper conformal coating in accordance with the procedures and to the standards outlined in MIL-STD-454D and MIL-C-47256 (MI).
2. REMOVE conformal coatings from printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in VOLUME 6 of the PACE Rework and Repair Technology Series.
3. REMOVE printed circuit components parts using the correct tools and desoldering techniques following the procedures and to the standards outlined in Volume 6 of the PACE Rework and Repair Technology Series.
4. REPAIR damaged printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in MIL-STD-454D.
5. CONNECT wires to turret terminals, hook and pierced tab terminals, bifurcated terminals and connected pins using the proper tools and soldering techniques following the procedures and to the standard outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4(3A).
6. REPLACE component parts on micro-electronic printed circuit boards using the correct tools and soldering techniques and apply the proper conformal coating in accordance with the procedures and to the standard outlined in MIL-STD-454D.

7. REMOVE conformal coating from micro-electronic printed circuit boards using the proper tools and techniques following the procedures and to the standards outlined in Volume 6 of PACE Rework and Repair Technology Series.
8. REMOVE micro-electronic printed circuit board component parts using the correct tools and desoldering techniques following the procedures and to the standard outlined in Volume 6 of the PACE Rework and Repair Technology Series.
9. PERFORM preventive maintenance on the 2M Repair Station following the procedures and to the standards outlined in the applicable technical manual.

C. Reason for the course

1. Despite component reliability 1,000 times better than in the past, circuit density has increased 100,000 times. Consequently we have an ever increasing number of component failures to deal with.
2. Even with the increasing failure rate, approximately 80% of the failures occurring today happen to assemblies which have been previously repaired. This shows that during some part of the repair cycle the assembly is being damaged or degraded in some manner.
3. A large part of the damage and degradation can be traced to a lack of correct training and equipment. Because of this lack, most technicians are causing serious degradation to the assemblies they repair, resulting in an increased failure rate and a much shorter assembly lifetime.
4. Before today's highly sophisticated electronic systems were developed, the soldering program, at both the manufacturing end and in repair, was quite lax.
5. Thus, to achieve a repair reliability in keeping with modern component reliability, this course was devised to teach you, the repair technician, the latest and best high-reliability repair techniques.

1399

#### E. Course Schedule

1. First week Printed Circuit maintenance
2. Second week Terminals and Connector Pins
3. Third week Micro-miniature Printed Circuit Soldering

*Note: Sections D and F have been omitted  
because of military specific materials.*

#### G. Safety

1. Personal
  - a. Handle and store heat tools properly to avoid burns.
  - b. Handle and store pointed and edged tools properly to avoid cuts.
  - c. Be extremely careful of rotary tools, particularly when using cutting bits.
  - d. When using rotary tools always use eye protective goggles.
  - e. Avoid prolonged skin or breathing contact of all chemicals used in the course.



- f. Avoid all eye, mouth, and open cut contact with chemicals used in the course.
- g. Do not breath dust particles from cutting and grinding operations.
- h. Avoid any possibility of igniting flammable chemicals or materials.
- i. Teflon releases toxic fumes at 400 degrees F. Be especially careful when thermally stripping wire as the element exceeds 400 degrees F and will cause fuming of Teflon insulation.
- j. Use common electrical safety to avoid shocks.
- k. Do not heat solvents. Some solvents release toxic fumes when heated. (For example, Chlorine and Phosgene gas)

## 2. Equipment

- a. Never perform any action on the workpiece that will cause damage or degradation.
- b. Handle all workpieces as though extremely fragile.
- c. Maintain cleanliness at all times.
- d. NEVER put enough strain on rotary tools to make them load down or bind.
- e. NEVER drop or bang an electrical power tool.
- f. Check all electrical cords for damage from hot tools, solvents or abrasion.
- g. Properly clean all tools and store in the proper place.
- h. Use each tool only in the manner for which it was designed to be used.

## H. Work Station Inventory

- a. Instructor will point out all tools and materials in the workstation.

## ASSIGNMENT SHEET 1-3-1A

TITLE

Introduction to High Reliability Soldering

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 1.3.1 IDENTIFY the characteristics of high reliability solder connections which include soldered area, solder quantity, solder finish, wetting and solder defects. Identification will be in complete agreement with the information contained in MIL-STD-454D and NHB 5300.4(3A).
- 1.3.2 OBSERVE all applicable equipment and personnel safety precautions, throughout the entire course of instruction, in accordance with the safety outlined in NASA Handbook SP-5002. (1.8)

STUDY ASSIGNMENT

Read and study Notetaking Sheet 1-3-1N of the Student's Guide.

STUDY QUESTIONS

1. Describe the identifying characteristics of Eutectic solder.
2. Solder is an intermetallic bond created by \_\_\_\_\_ action.
3. A solder connection having a slight grainy and lumpy appearance is an indication of \_\_\_\_\_.
4. What is a "fractured solder joint"?
5. At what temperature does 60/40 solder liquify?
6. A preferred solder connection forms a concave fillet from a point \_\_\_\_\_ way up the side of the lead.

## NOTETAKING SHEET 1-3-1N

TITLE

Introduction to High Reliability Soldering

REFERENCES

MIL-STD-454D

NHB-5300.4(3A)

Federal Specification QQ-S-571E

MIL-S-45743C

NOTETAKING OUTLINEA. Characteristics of solder and solder bonding

## 1. Analysis of solder composition

- a. Solder is a metal alloy consisting of two or more metals used in various percentages to form the solder alloy.
- b. The various elements which may be used to make up solder are listed below, along with their chemical symbols;
  - (1) Tin-Sn
  - (2) Lead-Pb
  - (3) Silver-Ag
  - (4) Antimony-Sb
  - (5) Bismuth-Bi
  - (6) Copper-Cu
- c. Bismuth and antimony are added to solder in very small percentages for special purpose applications, and only in very rare instances will alloys containing these metals be used as electronics solders.
- d. Copper is sometimes added to solder to saturate the alloy with copper molecules and thus slow down the solvents solvent action (called solder washing) on soldering iron tips; (the solvent action of solder will be explained later in this lesson).
- e. Silver is sometimes added to solder to achieve the same slowdown of solder washing on silver-plated nonsolderable surfaces of certain components such as ceramic capacitors.

f. The solder most commonly used in electronic soldering will be an alloy of tin and lead without special additives.

(1) The two most common alloys are 60/40 and 63/37

(2) Tin/Lead solder alloys are always given as a percentage with the tin content listed first, e.g., 60/40 is 60% tin and 40% lead.

2. The effects of heating and cooling on solder.

a. The diagram in Fig. 1 shows a plot of various tin/lead solder alloys versus temperature.

(1) Note that at 361°F, all tin/lead solders from a range of 15/85 to 95/5 change from a solid to a plastic (partial liquid) state except one.

(2) An alloy which has a single sharp melting point and changes directly from a solid to a liquid with no plastic state is called an EUTECTIC alloy. The only tin/lead solder alloy with eutectic characteristics is 63/37, as the diagram shows. The 63/37 solder is known as eutectic solder.

(3) Also notice that the different alloys reach full liquid state at different temperatures.

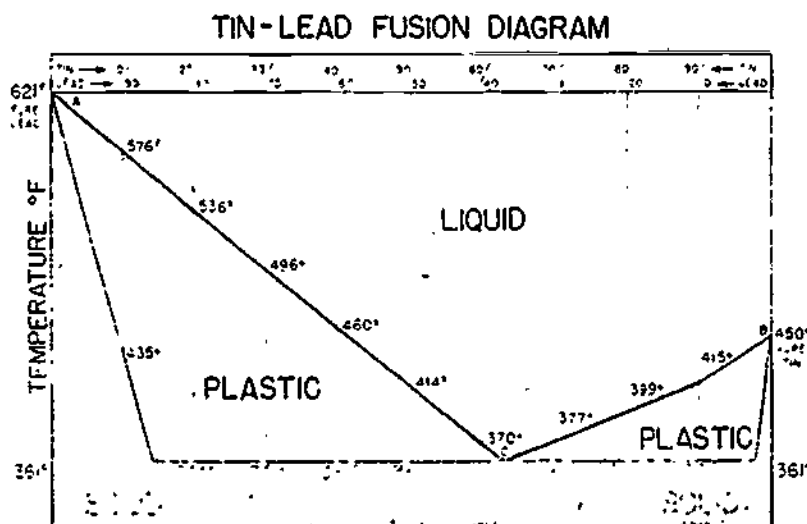


Fig. 1  
The Tin-lead Fusion Diagram

- b. An overall evaluation of the diagram shows that as solder is heated, it passes from a solid state through a plastic state and into a liquid state, with the exception of the eutectic point at which there is no plastic state.
- c. The most critical area of concern during a soldering operation is the time-temperature range during which the solder is in a plastic state.
  - (1) While in a plastic state the solder is a combination of a liquid tin/lead alloy in combination with solid pure metal crystals of either tin or lead.
  - (2) The particular alloy being worked with, in relation to the eutectic point, will determine whether the solid crystals are pure tin or pure lead.
  - (3) If the alloy is lead-rich in relation to the eutectic point, the crystalline structure will be of pure lead.
  - (4) If the alloy is tin-rich in relation to the eutectic point, the crystalline structure will be of pure tin.
  - (5) Any physical movement of the solder itself, while cooling through the plastic state, will permanently damage the intermolecular crystalline structure of the solder alloy, resulting in a fractured solder connection.
  - (6) For this reason eutectic solder, 63/37, is the best general purpose, high-reliability, electronic solder.
  - (7) 60/40 solder, which is also highly acceptable for electronic soldering, has the advantage of forming a slightly stronger joint than 63/37 solder. 60/40 solder, however, has the disadvantage of having the plastic range from 361°F to 370°F, and the resulting chance of fractured solder connections.

3. Soldering flux: Types, Purpose, Characteristics, and Effects on intermetallic bonds through wetting action.

- a. Soldering fluxes may be divided into three general types or classifications.
  - (1) Chloride (commonly called acid) type flux.
  - (2) Organic type flux.
  - (3) Rosin or resin type fluxes.

1405

- b. The purpose of soldering flux is to remove surface oxides from metals to be soldered.
  - (1) All metals oxidize when exposed to air.
  - (2) The process of oxidation causes a thin film of oxide, which is nonmetallic, to form on the surface of the metal.
  - (3) Good metal-to-metal contact must be obtained before soldering action may take place, and the oxide film prevents metal-to-metal contact.
  - (4) Flux chemically breaks down surface oxides causing the oxide film to loosen and come free from the metals being soldered.
- c. Each group of fluxes has characteristics which are specific to that group.
  - (1) The chloride fluxes are inorganic salts and are the most active of the three flux groups. They are effective on all common metals except aluminum and manganese, but are not suitable for fine electronic soldering since they are highly corrosive, usually electrically conductive, and difficult to remove from the workpiece.
  - (2) The organic fluxes are nearly as active as inorganic fluxes and they are less corrosive and easier to remove than inorganic fluxes. They are still not satisfactory for electronic soldering because they must be removed completely to prevent corrosion and because they have an extremely short lifetime at high temperatures.
  - (3) Rosin-type flux is ideally suited to electronic soldering due to its unique characteristics. The molecular structure of rosin, while inert at normal temperatures, breaks down and becomes highly active at soldering temperatures. This characteristic makes rosin totally noncorrosive, except at soldering temperatures. In addition, rosin is nonconductive, having  $3.3 \times 10^{15}$  (3,300 trillion) ohms per cubic inch resistivity. Rosin fluxes are rosin based, with additives that change some of the characteristics of the pure rosin flux.
- d. In addition to removing oxides, a good soldering flux must also aid in forming the intermetallic solder bond by improving the wetting action of the solder.
  - (1) Flux aids wetting action primarily by lowering the existing surface tension between the metals being soldered and the liquid solder.

- (2) Some improvement to wetting action is also given by the floating action of the flux which causes loosened oxides to be carried away from the solder flow path.
- e. To attain highest reliability in making electronic solder joints, the use of flux is a necessity.
- f. Flux is available as both an external agent and as an integral part of the solder.
- g. As an external agent the flux is applied to the connection by hand prior to soldering.
  - (1) External fluxes will range from a very thin liquid to a thick heavy paste.
  - (2) Most paste fluxes contain zinc chloride as an activating additive. If zinc chloride has been added, it will be stated on the container.
  - (3) Fluxes containing zinc chloride should NEVER be used for high-reliability soldering since they ARE corrosive.
  - (4) Zinc chloride also gives off highly toxic fumes when heated to soldering temperatures.
- h. Nearly all electronics solder in use today contains flux as an integral part of the solder.
  - (1) Flux is made an integral part of the solder by making the solder with a flux core.
  - (2) There are four standard flux core sizes as specified in Federal Specification QQ-S-571E, which are: 4.5%, 3.3%, 2.2%, and 1.1% by volume.
  - (3) The flux content of solder is measured in percentage by volume and, for a given core type, will remain a constant percentage regardless of solder gage.
- i. It is permissible and often highly desirable to use an external flux in conjunction with flux-cored solder.
- j. Two types of external flux are recommended for high-reliability electronic soldering by Military Specification MIL-S-45743C.
  - (1) Kester Solder Co. No. 1544, with No. 104 thinner.
  - (2) Alpha Metals Co. No. 711, with No. 412 thinner.

k. In addition to wire-type solder which is most often used in repair, there are special preforms and shapes of solder available.

- (1) Solder preforms are for applying precise amounts of solder to a particular type of connection on a repetitive basis, such as in manufacturing production lines.
- (2) They are also used in production when the connection is not accessible by hand when it is soldered, such as sealed cans and evacuated atmosphere units.
- (3) The special forms are quite expensive and not normally needed for repair work, but the repair technician should be aware of their availability should the need for their use arise in special cases.
- (4) The forms are available as both flux-cored and as solid solder.
- (5) A wide range of special preforms of solid flux similar to the solder preforms are also available for special application use.

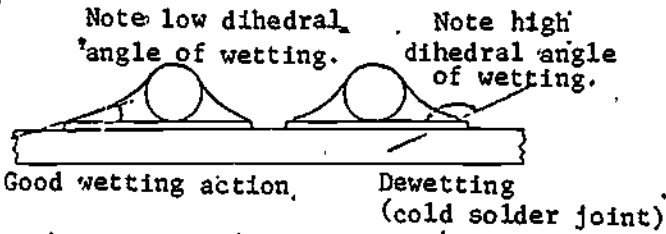
l. Detailed specifications and standards for fluxes and flux-cored solders may be found in the following publications:

- (1) Federal Specification O-F-506-B
- (2) Federal Specification QQ-S-571E
- (3) Military Specification MIL-S-6872A
- (4) Military Specification MIL-F-14256C-1
- (5) Military Specification MIL-F-20329A
- (6) Military Specification MIL-S-45743C

4. The intermetallic bond and wetting action.

- a. Solder does NOT act as an adhesive or glue in bonding metals together.
- b. Solder forms an actual intermetallic bond with solderable metals, but it does NOT do so by fusion as in brazing or welding where all metals to be bonded must be molten to fuse together.
- c. The intermetallic bond formed by solder is a solvent or solution action.



- (1) An illustration of this solution action can be shown with plastics which will melt at a fairly high temperature, but will dissolve at room temperature when placed in a solvent such as acetone.
  - (2) This dissolving action is the method by which solder forms an intermetallic bond (solution) with copper and other metals that are solderable, much the same as with acetone on plastic.
  - (3) The bond formed by solder is then a completely new alloy consisting of solder (tin and lead) in solution with the metal being soldered.
  - (4) The soldered connection is a single complete piece of metal even though it does consist of at least three separate alloys (the base metal, the base metal and solder, and solder).
- d. The wetting action of solder is the degree of ease and completeness with which the solder spreads over the surface of the metal being soldered.
- e. The completeness of the wetting action is measured by the tangent angle where the solder meets the surface of the metal being soldered, called the dihedral angle of wetting.
- 
- (1) A very small angle is an indication of thorough and complete wetting.
  - (2) A large angle formed by a sphere or bubble of solder (similar to a drop of water on a waxed car hood) is an indication of poor wetting.
- f. The completeness of the wetting action is one of the prime indicators of quality and reliability when inspecting a solder joint.

## B. Metallic platings

### 1. Purpose of platings

- a. It is the function of platings to protect the metal they cover by preventing oxidation.
- (1) The prevention of oxidation also keeps the base metal in a clean and highly solderable condition.

- (2) One of the best platings for prevention of oxidation is gold, as it is the lowest of the electromotive series of elements. Gold is quite porous, however, and must thus be applied in a relatively thick layer to accomplish its job.

b. Plating is also used on component leads which are made of a solderable metal.

- (1) Some nonsolderable metals are used to make component leads where they are needed to obtain special strength, flexibility, and thermal expansion characteristics.
- (2) In this case the lead is plated with a solderable metal so that it may be soldered into a circuit.
- (3) When this situation exists, care must be taken not to damage or remove the plating from the base metal.

## 2. Effects of plating on the intermetallic bond.

- a. To understand the effects of plating, it is necessary to understand that platings form a physical attachment with the base metal and NOT a metallic alloy.
- b. Thus, soldering to the plating metal alone becomes unsatisfactory as no true intermetallic bond is established with the base metal.
- c. One solution to this problem is to remove the plating from the area to be soldered as part of the soldering preparation.
  - (1) This may be done by using a rubberized abrasive such as a typewriter eraser if the plating is a soft metal such as gold. This method will only work where surface shape and spacing make it practical.
  - (2) If the plating is hard or the surface is very irregular, removal of the plating may be accomplished by tinning heavily with solder and then removing the solder. Since the solder has alloyed with the plating metal, most of the plating metal will be removed along with the solder. It may be necessary to perform this operation several times to gain satisfactory plating removal, thus making heat tolerance a prime consideration when using this technique.
- d. Another method of obtaining a good intermetallic bond on a plated surface is to apply sufficient heat and time for the solvent action of the solder to penetrate through the plating and form an alloy with the base metal. While this method will work with most platings there are other factors to be considered.

- (1) The method does not work well with very hard plating metals due to the slower solvent action of the solder.
  - (2) The plating must be relatively thin for this method to work reliably.
  - (3) The alloy of the plating metal with the solder will, in some cases, cause the solder bond to lose strength or become brittle.
- e. The best solution to plating problems is being used by manufacturers. They are starting to hot-dip base metals in solder rather than electroplating them.
- (1) This works very well since the coating forms an actual intermetallic bond with the base metal rather than just a physical coating.
  - (2) This coating is naturally the easiest to solder to since you are, in effect, merely adding solder to an already established solder bond.
  - (3) Since this method can only be put into use at the manufacturing level, it is only necessary for the repair technician to be aware of its purpose and effects.
3. Determining if a plating will be harmful or advantageous to a connection.
- a. Only two platings, other than hot-dip solder, are commonly used on areas to be soldered.
- (1) These two platings are gold and silver.
  - (2) Many other platings are used in electronics, but they are used either in extremely rare instances or in areas which will not be soldered to, such as printed circuit edge connectors.
- b. Silver is used primarily on terminals and connector pins.
- (1) The shape and accessibility of such objects makes plating removal impractical and thus requires that the soldering operation take place with the plating intact.
  - (2) Silver wets and alloys well with solder, and does not detract from joint strength, so it has no harmful effect on the intermetallic bond.

- c. Gold is the most common plating metal and is used extensively on all types of electronic circuitry.
- d. Gold plating may be either very harmful or highly advantageous to soldering depending upon the specific purpose and area where it is used.
  - (1) Gold plating is very advantageous when used on a nonsolderable component lead since the component could not be soldered into a circuit without the solderable gold plating. For this reason it is necessary to take care in keeping the plating on component leads intact.
  - (2) Gold plating on areas such as printed circuit runs, pads, and eyelets is normally harmful to solder connections as it detracts from the solder joint reliability.
- e. There are several detrimental effects caused by gold when it is present in the solder connection in quantities greater than 5% by weight.
  - (1) Pull test results show the effect of reduced solder bond strength.
    - (a) Pull separation strengths were measured between a copper wire soldered to a gold-plated copper run and a copper wire soldered to an unplated copper run.
    - (b) The bond with gold present had only a little over half the strength of the bond with no gold.
    - (c) The loss of strength is due to the gold which is alloyed with the solder. The portion of the solder which has gold dispersed through it becomes the weakest part of the bond.
    - (d) The bond with no gold present separates at the thinnest point of the connection, as should be the case with any good strong intermetallic bond.
    - (e) The bond which contains gold separates at the surface of the copper run where the heaviest concentration of gold is present.
  - (2) Gold is also detrimental in that it causes the solder bond to become brittle.

- (a) A brittle solder bond is highly undesirable since it is subject to cracking under stress such as the thermal expansion and contraction common to electronic circuits.
  - (b) The brittleness is caused by the porous nature of gold which is not lost when it forms an alloy with solder.
  - (c) A visual indication of this is usually present in the form of a rough "frosty" solder connection appearance.
- (3) The final detrimental effect of gold on a solder bond is that of decreased wetting action.
- (a) This is evidenced by a very high dihedral angle of wetting.
  - (b) The result is a reduced spread area of the applied solder.
- f. The detrimental effects of gold on a solder connection make it necessary to remove gold plating from a connection area, whenever possible, before soldering.

#### C. Characteristics and fabrication of a quality solder joint

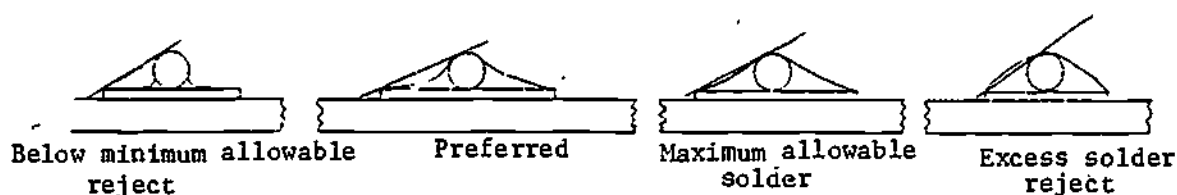
##### 1. Physical appearance

- a. The most obvious visual indication of a quality solder joint is a smooth and shiny mirror-like surface.
- b. The joint surface must be totally free of any pits, protrusions, or other blemishes.
- c. There must be no copper showing through the soldered area at any point.
- d. The solder will form a smooth concave fillet between the component lead and the surface it is soldered to at all points of the soldered area.
- e. The most critical indication of quality and reliability of a soldered connection is the wetting action of the solder.
  - (1) There must not be any distinct inlets at the edge of the soldered area where the solder did not flow.
  - (2) The solder must wet and blend smoothly into the soldered surfaces at the edge of the soldered area leaving no sharp edge or ridge at any point where the solder has stopped flowing.

## 2. Solder quantity

### a. The preferred quantity of solder on a connection.

- (1) The solder forms a smooth concave fillet from a point about one half of the way up the side of the lead.
- (2) The contour of the wire is clearly visible through the solder (if the wire is stranded, the individual strands must be visible).



### b. The maximum acceptable quantity of solder on a connection.

- (1) The solder fillet starts about three-fourths of the way up the side of the lead.
- (2) The connection is very near to having too much solder since the fillet is only slightly concave.

### c. An excessive quantity of solder on a connection.

- (1) The fillet is convex rather than concave.
- (2) It is not possible to tell if the lead is even in the solder joint since it is completely hidden by the solder.
- (3) It is possible for many defects, such as air pockets, to exist within the joint and not show through to the solder surface.

### d. An insufficient quantity of solder on a connection.

- (1) The fillet, although concave, starts well below the halfway point of the lead.
- (2) Even though the intermetallic bond is good, there is not enough of it to withstand vibration and expansion stresses. This would result in solder cracking and assembly failure within a short time.

## 3. Internal structure

- a. The internal metallic structure of a good solder connection consists of several different alloys.

- b. The following list would be the alloys that make up a solder connection between a tinned copper lead and a copper printed circuit pad.
    - (1) Solid copper forming the pad.
    - (2) Copper, tin and lead alloy on the surface of the pad.
    - (3) Tin and lead alloy in the center of the joint.
    - (4) Copper, tin, and lead alloy on the surface of the component lead.
    - (5) Solid copper forming the component lead.
  - c. All of the alloys must be complete with no air pockets, foreign substances, or other solder defects in the joint to obtain a reliable internal structure.
  - d. The only positive tests of the internal structure are X-raying or destructive examination, neither of which is practical for the repair technician.
  - e. The repair technician must judge the internal quality of the joint by learning the external appearance of defects and their causes.
- D. Recognition and causes of solder-joint defects.
- 1. Description of common defects.
    - a. NASA lists over 40 different solder-joint defects.
    - b. All of these defects fall under five major categories, and a knowledge of these five categories is sufficient for the repair technician.
    - c. The most common defect is a dirty solder joint which has a good outward appearance except for its wetting action.
      - (1) The edges of the solder will show a lack of good wetting action, also known as dewetting.
      - (2) Very distinctive of this type of defect is the indication that only one portion of the soldered area shows dewetting, usually less than one-half of the circumference.
      - (3) In the dewetted area there will usually be small inlets going back into the solder where it did not flow.



d. Another common defect is the cold solder joint which also has a good outward appearance except for its wetting action.

- (1) The dewetting seen in this type of defect differs from that of the dirty joint in that it usually has dewetting around all or most of the soldered surface.
- (2) An additional indication which may be present is a small protrusion or tip of solder sticking up from the surface where the soldering iron tip was removed from the joint.

e. Another defect is the fractured or disturbed solder joint.

- (1) The surface is usually semishiny and there is good wetting.
- (2) The prime indication of this defect is a spider-webbed or cracked, fissured appearance to the surface of the solder.
- (3) On some occasions large cracks may appear around component leads.

f. The next type of defect is an overheated solder joint (often mistakenly called a cold solder joint even though the appearance is quite different).

- (1) The surface of this joint is generally quite dull.
- (2) The prime indication of this defect is a rough, grainy, or sandy appearance.
- (3) The appearance may be lumpy rather than sandy if overheat is just beginning.

g. The last defect category is dead solder, which has indications very unique and different from any other type.

- (1) The first indication is a crusty or wrinkled appearance as if there is a film over the solder surface.
- (2) The solder will be a very dark dull color and may have faint light and dark streaks in it.

## 2. Causes of common defects.

a. The dirty solder joint is caused by oxidation or other foreign matter interfering with the wetting action of the solder.



- b. The cold solder joint is caused by insufficient heat applied or poor transfer from the tip of the soldering iron.
- c. The fractured solder joint is caused by physical movement of the solder while it is cooling and changing from a liquid to a solid.
- d. The overheated solder joint is caused by applying too much heat for too long of a time.
- e. 'Dead' solder is a condition of a very extreme overheat in which the tin and lead components of the solder may acutally begin to separate, and is generally only seen in solder left on the tip of the iron when not in use.

## ASSIGNMENT SHEET 1-4-1A

TITLE

Preventive Maintenance of the 2M Repair Station

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 5.1.1 PERFORM daily preventive maintenance actions on the SX-200 Solder Extractor following procedures outlined in the technical manual.
- 5.1.2 SERVICE hot cubby unit daily as outlined in the PACE Maintenance Manual for the SX-300 System.
- 5.1.3 INSPECT and CLEAN the Moto Tool as required to remove all foreign matter.

STUDY ASSIGNMENT

None

STUDY QUESTIONS

None

## JOB SHEET 1-4-1J

TITLE

Preventive Maintenance of the 2M Repair Station

INTRODUCTION

The purpose of this job sheet is to provide the student with guidance and "hands-on" experience in performing preventive maintenance on the 2M Repair Station so that he might be able to perform related associated duties aboard his duty station.

REFERENCES

PACE 810-001

SODR-X-TRACTOR SX300 General Operating  
and Maintenance InstructionsEQUIPMENT AND MATERIALS

MERP/2M Equipment Kit

JOB STEPS

1. Perform step 2a and 2b listed on page 17 of the SODR-X-TRACTOR SX300 General Operating and Maintenance Instructions.

SELF-TEST ITEMS

None

## ASSIGNMENT SHEET 2-1-1A

TITLE

Printed Circuit Board Component Installation and Soldering

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 2.1.1 POSITION components on single and double sided printed circuit boards, using preferred mounting as outlined in MIL-STD-454D.
- 2.1.2 SHAPE component leads for mounting on printed circuit boards without damaging leads or components and meeting all bend specifications as listed in MIL-STD-454D.
- 2.1.3 REPLACE electronic components on printed circuit boards utilizing the proper tools and soldering techniques for high quality printed circuit solder connections following the procedures and to the standards as outlined in MIL-STD-454D.
- 2.1.4 INSPECT printed circuit solder connections on selected boards and DETERMINE that quality and reliability are in accordance with the standards outlined in MIL-STD-454D.
- 2.1.5 IDENTIFY the conformal coating application techniques that should be used on various repaired printed circuit boards. Identification will be in complete agreement with the information contained in MIL-C-47256(M.I.).

STUDY ASSIGNMENT

Read and study Notetaking Sheet 2-1-1N of the Student's Guide.

STUDY QUESTIONS

- 1. What techniques are used for applying conformal coatings on printed circuit boards? \_\_\_\_\_,
- 2. What is the minimum distance from the component body to the start of the bend in the component lead?
- 3. Disregarding all characteristics except cleaning ability, what is the most preferred solvent for general purpose cleaning?

## NOTETAKING SHEET 2-1-1N

TITLE

Installation and Soldering of Printed Circuit Components

REFERENCES

MIL-STD-4540

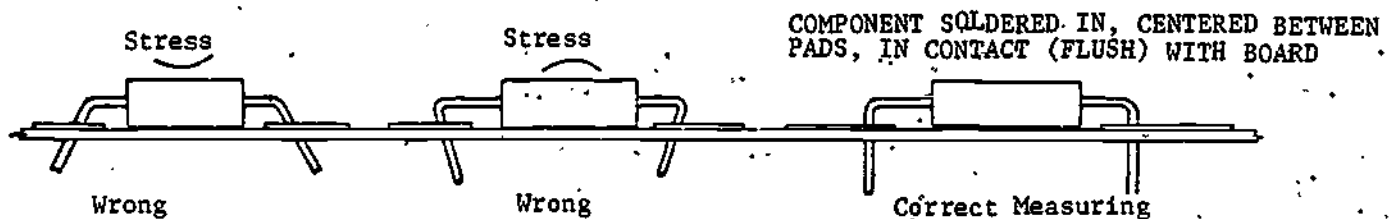
MIL-C-47256(M:I)

NOTETAKING OUTLINE

## A. Proper positioning of a component on a printed circuit board

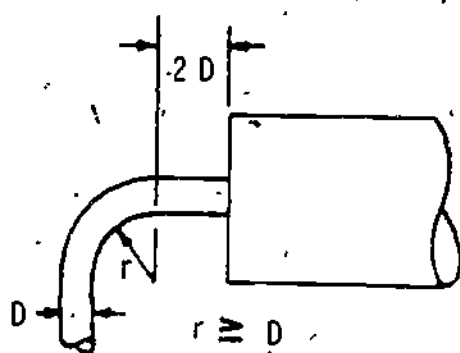
## 1. Specifications and standards

- a. In repair, replacement components should always be installed in conformance with the original configuration.
- b. Component bodies shall be centered between the component lead mounting points whenever design permit, and flush mounting is the preferred method.

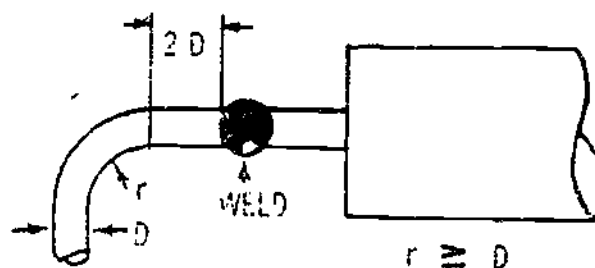


- c. Replacement components shall be mounted so as to make all possible identification markings readable without disturbing the component.
  - d. When a series of components are mounted in the same style and direction, they should be placed so that the markings on all are readable from a single point (giving due regard to polarity requirements).
  - e. Any mounting hardware removed during disassembly shall be replaced when installing new components.
2. Considerations to be made.
- a. The following considerations take mandatory precedence over preferred mounting styles.
    - (1) Proper mounting of polarized components
    - (2) Physical space limitations of original design.

- b. When mandatory mounting considerations have been met, preferred configurations should be used.
- B. Methods of shaping component leads for mounting on a printed circuit board.
  1. Specifications and standards.
    - a. Component leads shall always be straightened and cleaned prior to shaping.
    - b. Leads may be straightened by hand using anything that will NOT cut or scrape the lead.
    - c. Eraser cleaning of leads is preferred.
      - (1) Use an ink-type eraser (white) for this purpose as other types of erasers will leave an oily film on the lead.
      - (2) After cleaning the leads with any method, the final cleaning step should be to wipe the lead thoroughly with solvent to remove any particles left by the other cleaning method.
    - d. The minimum distance between the seal, where the lead enters the body of the component, and the start of the lead bend shall be NO LESS than a distance equal to twice the diameter of the lead itself.
    - e. The minimum distance between any weld bead on the lead and the start of the lead bend shall be NO LESS than a distance equal to twice the diameter of the lead itself and the bend shall NOT be between the weld bead and the component body.
    - f. The minimum radius of the bend itself (sharpness of the bend) shall be NO LESS than a distance equal to the diameter of the lead, and the bend angle shall be 90 degrees at all times, except when forming a stress relief bend.

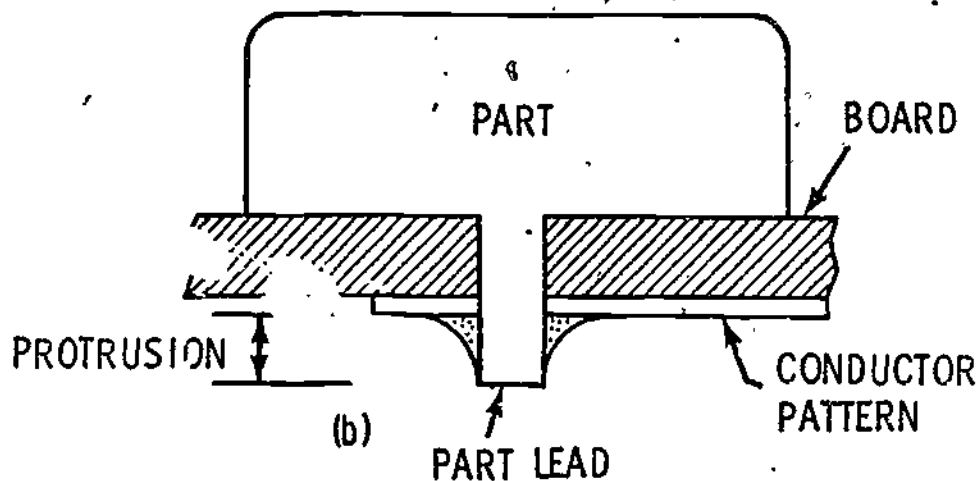


(a) STANDARD LEAD



(b) WELDED LEAD

- g. After bending leads, and before inserting the component on the board, always re-clean the leads with solvent to remove any skin oils and salts present due to finger contact.
- h. After installing the component on the board, the proper lead termination must be made prior to soldering.
  - (1) Prior to shaping lead termination, excess lead can be cut off with a flush-cutting tool.
  - (2) On clinched terminations the lead length shall be not less than the radius of the pad and not greater than the diameter of the pad.
  - (3) Semiclinched terminations have the same length specifications as full clinches.
  - (4) All clinched terminations must be bent in the direction of a run.
  - (5) Full clinch terminations must contact the run surface and not overhang any part of the run edge.
  - (6) The lead length of straight-through terminations shall be not less than one lead diameter and not more than two lead diameters above the board surface.

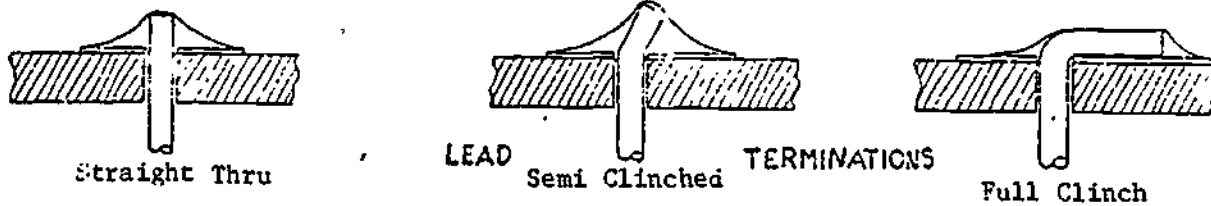


- i. Proper shaping techniques
  - (1) The first step in preparing for component installation is to thoroughly clean the circuit board.
    - (a) A white ink type eraser will remove light oxides and gold platings.

- (b) Heavy oxides and thick platings may be removed with mechanical abrasion.
  - (c) Always clean the board with solvent and a kimwipe after abrading and DO NOT let the solvent evaporate, but wipe it away with a clean DRY kimwipe.
  - (d) Solvent cleaning may also be done with a brush. Always use a brush which has soft bristles to prevent scratching the conductor surfaces, and remember to wipe dry with a kimwipe.
- (2) The next operation in component installation is cleaning and bending the component leads prior to insertion in the board.
- (a) A nylon rod or orangewood stick may be used to bend component leads. Be sure to always hold the component body immobile and bend only the pigtail end of the lead with a smooth wiping motion of the finger.
  - (b) When using round nose pliers to form 90 degree bends and stress relief loops, always use EXTREME care not to dent the component lead.
  - (c) ~~The initial step in forming stress relief loops~~ is to make a standard 90 degree bend in the lead.
  - (d) To finish the stress relief bend, grip the lead just beyond the 90 degree bend, and wipe the pigtail end smoothly around the plier jaw, forming a 180 degree loop.
  - (e) The COMFORM1 tool is one of many types of special lead forming tools.
  - (f) Special tools, such as the COMFORM1 tool, may be used to measure proper component lead spacing. The sliding post must be locked into place with the setscrew after the posts are inserted into the component mounting holes.
  - (g) The upper forming posts of the COMFORM1 tool reflect the measured lead spacing. The component is inserted into the forming posts and the leads are then wiped firmly against the side of the forming post.
- j. After bending and inserting the component into the board, the next step is to properly form the lead termination.



- (1) If forming a straight-through termination, the lead is simply cut to proper length with flush-cutting pliers.



- (2) To form a semiclinched termination, grip the lead end with pliers and bend in the direction of a run to a 45 degree angle, without PULLING on the lead.
- (3) After bending, the lead is cut with flush-cutting pliers. The flush side of the cutter is ALWAYS kept towards the board.
- (4) For full clinch leads, the bending and cutting process is the same as for semiclinch leads.
- (5) An orangewood stick, which will not damage the board in any way, may be used to fully clinch the pigtail down to the run surface.

k. Characteristics of high quality printed circuit solder connections.

- (1) The soldered area extends beyond the cut end of full clinch leads sufficiently to form a fillet.
- (2) The solder must flow to the edges of the pad in all cases.
- (3) If the run or pad is plated and plating has been removed, solder shall be flowed over ALL exposed base metal.
- (4) On a single sided board the solder forms concave fillets between the lead and pad with no internal voids.
- (5) On a double-sided board with plated-through holes or flat-set eyelets, the solder should completely fill the hole and cover the pads on both sides of the board.
- (6) The soldered area of a funnel-set eyelet forms three separate solder joints; one on each side between the outer flanges and the pad, and one through the hole between the inside of the eyelet and the lead.

(7) Solder finish and wetting.

(a) The solder finish must exhibit the following characteristics

1. A smooth gleaming mirror-like appearance
2. No pits or holes
3. All fillets must be concave

(b) Solder wetting characteristics must be as follows

1. The edges of the solder flow must blend smoothly into the soldered surface with no ridged or bubbled appearance.
2. There must be no bays or crevices extending back into the solder flow.

1. Techniques for making high quality printed circuit solder connections.

(1) Application of flux

- (a) Only flux-cored solder should be used, as it provides automatic application of flux to the connection while soldering.
- (b) For large areas or rapidly oxidizing surfaces a quantity of external flux may also be applied to the joint prior to soldering.

(2) Proper heating

- (a) Proper heating can only be accomplished with a correctly prepared soldering iron.
  1. A typical soldering iron used in high reliability soldering has different tip sizes which are used for different masses to be soldered.
  2. The tip should be inserted to the bottom of the hole and the setscrew tightened gently, as excessive force will cause the screw to heat-sieze.
  3. Dressing soldering iron tips
    - a. Copper tips should be dressed with a smooth file, only when cold, to prevent oxidation and solder repulsion.

b. When using a plated copper tip, never dress the tip with a file. Clad tips should be cleaned only with a platers brush, or crocus cloth if heavily oxidized.

4. After cleaning or dressing the tip, it MUST be tinned by flowing a generous amount of new solder onto the SHAPED surface as soon as the iron is hot enough to melt solder. The iron is then allowed to idle for approximately 2 minutes until it reaches full operating temperature, at which time additional solder is added.

5. The solder is left on the tip if the iron is not going to be used immediately. This protects the hot tip from the rapid oxidizing effects of heat.

6. Before using the soldering iron to make a solder joint, all excess solder must be removed from the tip with a brush and kimwipe.

7. If the iron has idled for some time, fresh solder should be added to the tip prior to wiping off excess solder, this ensures that any impurities will flow to the surface of the solder and be removed during the wiping action.

8. After the excess solder has been wiped off, thermal shock the tip on a wet sponge to provide a clean, dry tip for soldering.

9. The thin plating (tinning) slows down oxidation and aids in heat transfer to the connection when soldering.

(b) To achieve proper heating of the connection, the tip size and the wattage of the element must be capable of rapidly heating the mass of the joint being soldered to the melting temperature of a solder.

(c) When soldering a small mass connection, the applied heat may be controlled by either decreasing the power to the iron with the variable AC control or by decreasing the size of the tip.

(3) Application of solder

2. The iron should not be moved during the soldering operation, even on double sided boards, since proper cleaning and heating of the joint area will allow the solder to flow through the hole and form the entire joint with a single application (except for holes without metallic reinforcement).
3. Solder is applied to the connection by painting the solder onto the area to be soldered using a circular motion. Start by forming fillets along the sides of the lead and tinning the cut end of the lead; finish by filling in the large flat area of the pad.

(4) Cleaning after soldering.

- (a) After the soldering operation is completed all flux residues must be removed by solvent cleaning.
- (b) The flux residue may be removed using solvent and a kimwipe or a bristle brush.
- (c) Do NOT allow the solvent to air-dry on the board as it will leave a thin layer of flux residue behind.
- (d) Many solvents are approved for circuit board cleaning. The four most highly recommended solvents in order of their overall cleaning effectiveness are:
  1. 99.5% pure ethyl alcohol
  2. 99.5% pure isopropyl alcohol
  3. 1.1.1 trichlorethane
  4. Freon TF

m. Inspecting completed printed circuit board solder connections for quality.

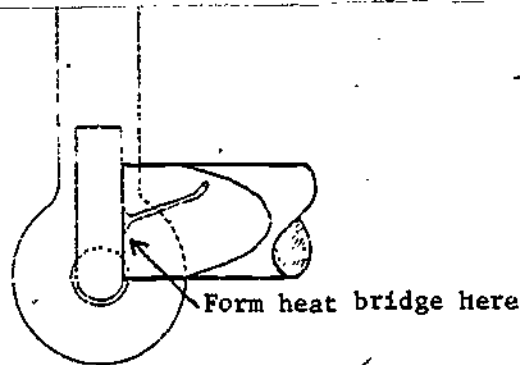
1. Standards of acceptance

- (a) The solder joint must possess the proper quantity of solder.
- (b) The solder finish must show no evidence of defects.

- (a) Before applying heat a thermal shunt should be attached to component leads if dealing with heat sensitive components such as diodes and transistors.

1. Care must be taken not to solder a copper thermal shunt into the circuit.
2. When component leads do not provide access for the thermal shunt attachment due to the use of mounting hardware, EXTREME care must be used to prevent heat damage. Some heat protection is provided by the mounting hardware and the additional lead length.

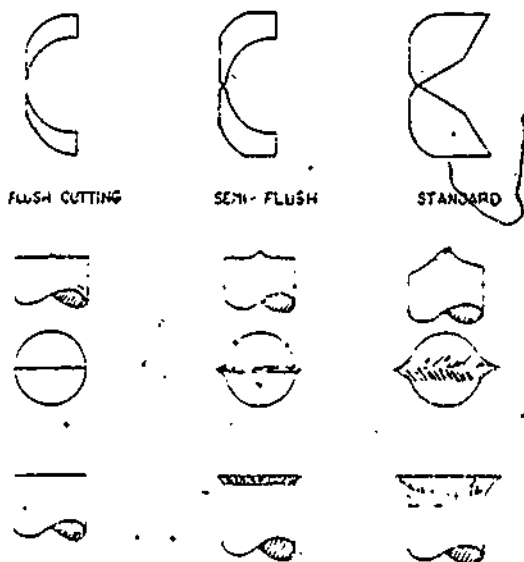
- (b) A solder bridge is formed by melting a small amount of solder at the junction of the tip and the joint. This forms a large area inter-metallic bond between the tip and the joint, effectively making the tip a part of the joint and allowing maximum possible heat transfer rate from the tip to the joint.



- (c) After the prepared tip is placed in physical contact with both the lead and the pad and the heat bridge has been established, the solder must be applied to form the solder bond.

1. Use only clean solder.

- (c) Proper solder wetting action.
  - (d) Proper lead termination styles.
  - (e) No board, conductor, or component damage.
- (2) Indications to look for.
- (a) Solder quantity
    - 1. Concave fillets
    - 2. Lead contour visible
  - (b) Solder finish
    - 1. Bright, gleaming finish
    - 2. No pits or holes
  - (c) Wetting action
    - 1. Smooth feathering of all solder edges.
    - 2. No bays or crevices in the edge of the solder flow.
  - (d) Lead termination
    - 1. Proper length
    - 2. Proper positioning
    - 3. Pigtail properly flush-cut



TYPES OF PLIER CUTTING JAWS AND RESULTING CUTS

## (e) Board, conductor, and component damage

1. Overheated board
2. Conductor delamination
3. Conductor nicks and scratches
4. Proper component installation

## (3) Reasons for rejection

## (a) Insufficient solder quantity

## (b) Poor wetting

## (c) Excessive solder quantity

## (d) Lead cut wrong

## (e) Disturbed solder

## (f) Overheated solder

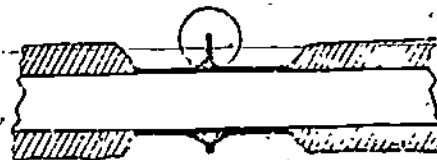
## (g) Fractured solder

## (h) Cold solder

## (i) Dirty solder

## (j) Dead solder

## (k) Copper exposed at the cut end of the lead



Re-install component, ensuring all specifications are met.

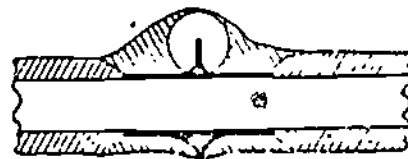
## n. Applying a conformal coating to a repaired printed circuit board

## (1) Preparation

- (a) All dirt, grease, and other foreign matter must be removed.
- (b) The board must be thoroughly dried and free of any dampness.

## (2) Application techniques

- (a) Dipping
- (b) Brushing
- (c) Spraying



Replace conformal coating, ensuring a complete seal to component and old coating.

- (3) Curing the coating
  - (a) Never cure any coating below normal room temperature
  - (b) Follow the manufacturer's directions for best results
- o. Final inspection of a repaired printed circuit board
  - (1) Standards of acceptance
    - (a) Board restored to its original configuration
    - (b) No visible degradation to any part of the assembly
    - (c) The conformal coating (if any) intact with no voids or imperfections
  - (2) Indications of reliability
    - (a) Repair made with the same type components and materials as used by the manufacturer
    - (b) Repairs made should be nearly indistinguishable by visual inspection, unless they distinguish themselves by being of a visibly higher quality than the original work of the manufacturer.
- p. Safety precautions
  - (1) Workpiece
    - (a) Never perform any action on the workpiece which will cause damage or degradation
    - (b) Handle all workpieces as though extremely fragile
    - (c) Maintain scrupulous cleanliness at all times
  - (2) Tool
    - (a) Clean and store all tools properly
    - (b) Never use excessive force on any tool
    - (c) Use each tool only in the manner it was designed to be used
  - (3) Personal
    - (a) Beware of burns from all hot tools



- (b) When using chemicals beware of skin, eye, and internal contact, and avoid excessive inhalation of fumes.
- (c) Use eye protection when using power tools, and when there is a chance of splashing chemicals.
- (d) Avoid any possibility of igniting flammable chemicals or materials.

## ASSIGNMENT SHEET 2-2-1A

TITLE

Conformal Coating Removal

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 2.2.1 IDENTIFY the basic types of conformal coatings listed in Volume 6 of the PACE Rework and Repair Technology Series and MIL-I-46058C, without error.
- 2.2.2 DETERMINE the proper conformal coating removal method to be used on selected printed circuit boards. Determination will be based on information contained in Volume 6 of the PACE Series.
- 2.2.3 REMOVE various conformal coatings from printed circuit boards using the chemical, heat, and abrasive methods and proper tools necessary as outlined in Volume 6 of the PACE Rework and Repair Technology Series.

STUDY ASSIGNMENT

Read and study Notetaking Sheet 2-2-1N of the Student's Guide.

STUDY QUESTIONS

None

## NOTETAKING SHEET 2-2-1N

TITLE

Conformal Coating Removal

REFERENCES

PACE Rework and Repair Technology Series, Volume 6

NOTETAKING OUTLINE

- A. Characteristics and recognition of common conformal coatings.
1. The six basic types of conformal coatings
    - a. Epoxies
    - b. Acrylic lacquers
    - c. Polyurethanes
    - d. Varnishes
    - e. RTV (Room Temperature Vulcanizing) materials
    - f. Parylene
  2. Methods of indentifying type of coating by characteristics.
    - a. Each type of coating has specific characteristics of hardness, heat resistance, adhesion, solvent reaction, texture and brittleness.
      - (1) In addition to the above characteristics, coatings are classed as being either thick or thin.
      - (2) A thin coating is considered to be 0.025 inches or less in thickness. All coatings thicker than 0.025 inches are classed as thick coatings.
    - b. Individual characteristics may overlap or appear to be the same; however, overall characteristics evaluation will determine the coating type.
  3. Specific characteristics of the six basic coatings.
    - a. Epoxy
      - (1) Epoxy is normally the hardest of the six types.
      - (2) The application of heat at or near the solder melting temperature causes the epoxy to overcure, resulting in a breakdown into a powdery substance.

- (3) Epoxy forms the strongest surface adhesion bond of all of the conformal coatings. It will not chip or peel and may be considered nearly unbreakable under physical stresses.
- (4) Very few solvents will attack epoxy, and the ones that do will also attack the components and circuit boards themselves in most cases. Therefore, solvent removal of epoxy coatings is NOT a recommended procedure and should be avoided. The cleaning solvents recommended in a previous lesson will normally not have any effect on epoxy coatings.
- (5) The texture of epoxy is normally hard, smooth, and nonporous, much as an extremely hard elastic.
- (6) Epoxy is normally very brittle, but due to its great adhesion strength, it does not chip or crack without the application of extreme stress.

b. Acrylic lacquer

- (1) Acrylics are relatively hard and similar in appearance to epoxies, but they yield more readily to scraping and cutting.
- (2) Heat readily softens most acrylics; however, it often results in a gummy residue.
- (3) The adhesion of acrylics is usually a surface bond only and will often chip and flake, although it is relatively strong.
- (4) Solvents, such as 1,1,1 trichloroethane and xylene readily attack and soften most acrylics.
- (5) The texture of acrylics is normally smooth, nonporous, and of medium hardness with a glossy finish similar to automotive lacquer paints.
- (6) Acrylics are quite brittle and chip readily, but due to their brittleness do not exhibit a tendency to peel in large flakes.

c. Polyurethane

- (1) Polyurethane coatings are found with widely varying degrees of hardness which range from an extremely hard type, which is similar to epoxy, to a relatively soft consistency which is similar to an RTV compound.

- (2) Upon application of heat, at or near solder melting temperatures, most polyurethanes tend to soften rapidly and become easily pliable exhibiting a putty-like consistency.
- (3) Polyurethanes normally form a medium-strength surface bond which has a tendency to peel or flake in larger pieces than acrylics.
- (4) Plastic solvents are generally the only type solvents that will attack polyurethane, and these will normally also attack the components and board. The cleaning solvents recommended in a previous lesson will normally not have any effect on polyurethane coatings.
- (5) The texture of polyurethane is normally smooth, glossy, and nonporous, but MAY be dented or scratched with light pressure such as a fingernail.
- (6) Polyurethanes are not brittle, and bend readily, causing them to tear or stretch rather than crack or break.

d. Varnish

- (1) The hardness of varnish will vary with age; new varnish is relatively hard and tough while old varnish tends to be brittle and flake very easy.
- (2) When heat, at or near solder melting temperature is applied to varnish, it liquifies and gives off a very strong and distinctive odor of linseed oil.
- (3) The adhesion of varnish coatings tends to be a surface bond that will peel readily, but cracks often.
- (4) Organic solvents such as alcohol and mineral spirits readily attack varnish, however, these solvents leave a gummy residue on the board upon evaporation.
- (5) The surface texture of varnish is often rather lumpy in appearance and has a semiglossy look.
- (6) Varnish is relatively brittle, therefore it flakes rather than peels.

e. RTV's

- (1) RTV's have a rubbery, pliable consistency.

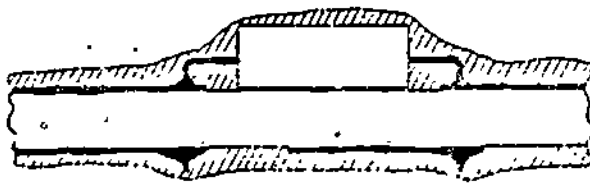
- (2) Heat, except in excessive amounts or for long durations, has little effect on most RTV's.
- (3) RTV's will be found to have a wide variety of adhesion strengths which range from readily peelable to extremely tightly bonded to the coated surface.
- (4) Common solvents have no appreciable effect on RTV coatings, although some may cause the surface to feel as if it has been greased with a slick lubricant.
- (5) The texture of RTV is smooth, dull, and rubbery.
- (6) RTV's are not at all brittle and stretch rather than chip or break.

f. Parylene

- (1) Parylene is considered to be a hard coating, and is normally as hard as epoxy.
- (2) Heat, approximately 480-500°F, applied with a hot knife will remove parylene; however, the chance of damage to the board is very high at this temperature.
- (3) The adhesion of parylene provides a tough pinhole free coating of uniform thickness that is very tightly bonded to the coated surface.
- (4) Parylene has no reaction to normal solvents.
- (5) The texture is smooth and dull, and normally clear.
- (6) Parylene is not brittle at all, and bends very easily.

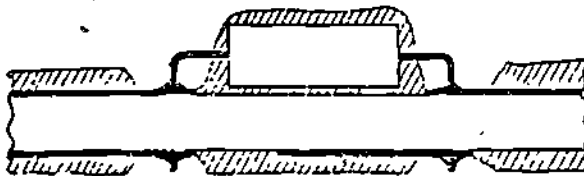
B. Coating removal area

- 1. The areas from which the coating MUST be removed in preparation for component removal from the circuit board are:
  - a. Remove the coating from all lead/pad areas on both sides of the board. This will allow for free airflow through the mounting holes during desoldering of the leads.
  - b. Remove the coating along all sides of the component to a point ON OR BELOW the widest profile of the body. Do NOT try to remove the coating all the way down to the board surface due to the chance of damage to the board.



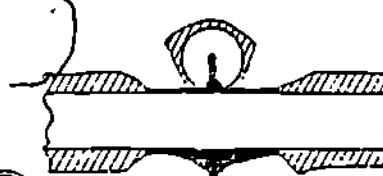
Problem: Remove bad component from heavy conformal coating on a double sided G-10 board with plated thru holes.

①



Remove conformal coating from pad areas on both sides of board (To ensure air flow for complete solder removal and cooling.)

②



### C. Methods of removing conformal coatings

#### 1. Chemical removal

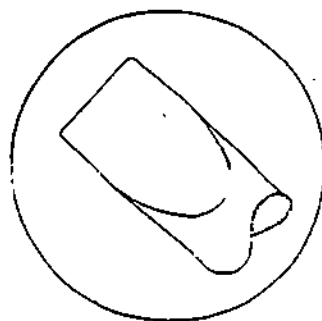
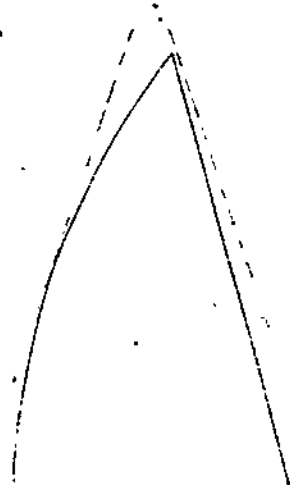
- a. Chemical removal consists of the removal of coatings using solvents.
- b. The only coating which is readily removable with solvents is acrylic lacquer applied in a relatively thin coating (less than 0.025 inches).
- c. Chemical removal procedures consist of the following steps:
  - (1) Apply the chemical solvent sparingly.
  - (2) Apply the solvent only to the area from which the coating MUST be removed.
  - (3) For best results the solvent should be applied with a small brush or swab.
  - (4) The solvent should be blotted up continuously to prevent its spreading into undesired areas and to allow new solvent to attack the newly exposed lower areas of the coating.
  - (5) Do NOT allow prolonged soaking in solvent, to prevent possible damage to the printed circuit or components.

## 2. Handtool removal

- a. Handtool removal consists of the removal of coatings using controlled heat, scraping, and peeling.
- b. Coating removal by controlled heat is effective on epoxies and polyurethanes.
- c. Scraping and peeling removal is effective on some polyurethanes and most RTV compounds.

## 3. Power tool removal

- a. Power tool removal consists of the removal of coatings by using abrasive grinding and abrasive cutting methods.
- b. Coating removal by abrasive cutting methods is effective on all coatings applied in a thick layer (greater than 0.025 inches).
- c. Abrasive grinding removal techniques are effective on all thinly applied coatings.



Slightly round off corners to help prevent gouging of board during coating removal operations.



## INFORMATION SHEET 2-2-11

TITLE

Conformal Coating Removal

INTRODUCTION

This information sheet is an aid to the student in determining the type of conformal coating and the best method for removing it.

REFERENCES

MIL-STD-454D, Military Standard for Electronic Equipment  
MIL-C-47255, Coating, Protective for Printed Wiring Board  
Volume 6, of the PACE Rework and Repair Technology Series

INFORMATION

The accompanying charts are to be used to help determine the type of coating and the best method for removing the coating.

CHART 1 - This chart shows the types of coatings and a list of characteristics that must be tested for. By matching the observed characteristics with the chart, you should be able to readily determine the type of coating on the printed circuit board under test.

CHART 2 - This chart shows the types of coatings and a list of the methods that may be used for removal of coatings. The methods are numbered for each type with the best (safest) method as the lowest and the least desirable (most dangerous) as the highest.

SUMMARY

The use of these charts should enable the student to identify and remove conformal coatings correctly. It is important to remember that any of these methods of conformal coating removal can cause damage to the workpiece, and must be used with care.

# CONFORMAL COATING CHARACTERISTICS

	HARD	MED. HARD	SOFT	HEAT REACTION	SURFACE BOND VERY STRONG	SURFACE BOND STRONG	SURFACE BOND MEDIUM	SURFACE BOND LIGHT	SOLVENT REACTION	SMOOTH SURFACE	LUMPY SURFACE	NONPOROUS SURFACE	GLOSSY SURFACE	SEMI-GLOSSY	DULL SURFACE	RUBBERY SURFACE	BRITTLE	CHIPS OFF	PEELS & FLAKES	STRETCHES	SCRATCH & BEND
EPOXY	X			X	X					X		X	X	X			X	X			
ACRYLIC LACQUERS		X		X		X			X	X		X	X				X	X	X		
POLYURETHANES	X	X	X	X			X			X		X	X						X	X	X
VARNISH	X	X		X		X			X		X			X			X		X		
R.I.V.			X		X	X	X	X		X					X	X				X	X
PARYLENE	X				X					X		X			X				X		X

47

1442

CHART 1

1443

766

TABLE 1  
SUMMARY OF THE MEDIAN CORRELATIONS  
BETWEEN EACH PREDICTOR AND SOME MEASURE OF SUCCESS  
FOR EACH PROGRAM\*

Vocational Program	Predictors							
	V INTEL	NV INTEL	ARITH	SPACE	MECH	PER- CEPT	DEXT	SPEC
Auto								
Mechanics	.20	.23	.17	.20	.23	.04	.09	.14
Carpentry	.14	.19	.06	.24	.27	.19	.18	.07
Drafting	<u>.39</u>	<u>.31</u>	.29	<u>.42</u>		.25	.07	.24
Electricity	.18	.21	.20	<u>.34</u>			.00	.24
Machine Shop	.25	.23	<u>.35</u>	<u>.30</u>	<u>.44</u>	.22	.14	.20
Industrial Arts	<u>.30</u>	<u>.33</u>	.29	.29	.25	.24	.10	.26
Business Education	<u>.44</u>	.28	<u>.48</u>	.23	.11	<u>.34</u>	.16	<u>.44</u> <u>.46</u>
Bookkeeping	<u>.44</u>	.11	.29	.15		<u>.32</u>		<u>.39</u>
Shorthand	<u>.40</u>	<u>.30</u>	<u>.38</u>	.16		.13		<u>.51</u> <u>.56</u> <u>.51</u>
Typing	<u>.30</u>	<u>.34</u>	<u>.36</u>	.23	.26	<u>.33</u>	.20	<u>.38</u> <u>.36</u>
Home Economics	<u>.38</u>	<u>.46</u>	<u>.44</u>	<u>.36</u>	.29	<u>.31</u>	.20	<u>.42</u>

\*Where blanks occur, medians were not calculated due to insufficient data (Prediger et al., 1968). This table was modified by underlining all median correlations above .30.

# CONFORMAL COATING

## REMOVAL TECHNIQUE

LISTED IN DESCENDING  
ORDER OF HARDNESS

	SOLVENT	ROTARY BRISTLE BRUSH	GRIT IMPREGNATED RUBBER WHEELS & DISCS	HOT AIR JET & ORANGE WOOD STICK	MODIFIED SOLDERING IRON	BALL MILLS, ETC.	CUTTING AND PEELING
PARYLENE		2		* 1 (F)	3		
EPOXY		3 (C)	4 (C)	1 * (C)	* 2 (B&D)	5	
ACRYLIC LACQUER	1 *	3	4 (C)	2			
POLYURETHANE	5 (A&C)	3 (C)	4 (C)	1 *	* 2		
VARNISH	1 (A&C)	3	4	2 *			
R.T.V.		2 (C)				1 *	

NOTE: THE PREFERRED ORDER FOR APPLYING INDIVIDUAL REMOVAL TECHNIQUES TO SPECIFIC COATINGS IS NUMERICALLY INDICATED. THESE REMOVAL TECHNIQUES ARE LISTED IN ASCENDING ORDER OF THEIR DAMAGEABILITY TO THE MODULE UNDER REPAIR. ANY OF THE METHODS LISTED MAY CAUSE DAMAGE IF NOT USED WITH CARE. ALWAYS TRY THE LEAST DAMAGE CAUSING METHOD FIRST. CONSIDER THE POSSIBILITY OF HEAT OR VIBRATION SENSITIVITY OF COMPONENTS (VIBRATION ESPECIALLY WILL AFFECT ALL AREAS OF THE WORKPIECE).

- \* DENOTES METHOD THAT POSITIVELY IDENTIFIES TYPE OF CONFORMAL COATING.
  - A. SPECIFIC TYPES OF COATING COMPOSITIONS ONLY.
  - B. FOR THICK COATINGS (.025 & THICKER).
  - C. FOR THIN COATINGS ONLY.
  - D. DO NOT ATTEMPT TO GRIND TO BOARD SURFACE WITH THIS METHOD.
  - E. ORGANIC SOLVENTS ARE BEST.
  - F. USE MODIFIED DRILL BIT FOR TIP (SHAPED TO BEVELED EDGE).
- CAUTION: USE WITH CARE, APPROXIMATELY 500 DEGREES F NEEDED AT TIP.

CHART 2

1414

1415

3. Success in high school occupational education programs does not appear to be correlated with manual dexterity.
4. Special aptitude tests, which require the ability to perform in areas closely related to a given occupation, appear to be correlated with success in high school vocational programs.
5. The effectiveness of a given predictor to predict success in a variety of occupations varies greatly. (For example, the correlation between verbal intelligence scores and success in carpentry was .14, while the correlation for business education and bookkeeping was .44; the correlation between nonverbal intelligence scores and success in home economics was found to be .46, while the correlation for bookkeeping was .11.)

Ghiselli (1966) conducted a literature review in which he summarized data pertaining to adults. His review covered the period from 1919 to 1966 and dealt both with prediction of success in training and on the job. He summarized the data under each of two occupational classification systems: the General Occupational Classification (GOC) and the Dictionary of Occupational Titles (DOT). Since the GOC system appears to represent a specific breakdown of occupations, it has been used in this summary. The correlation coefficients reported are based upon the mean correlation over a number of studies of a given predictor and criterion of success.

Ghiselli (1966, pp. 33-64) summarized in detail those types of measures that have predictive validity for success in various training programs and job success. He categorized measures according to the following system. It is interesting to note that his review includes personality measures as indicated in category 5.

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Intellectual Abilities               <ol style="list-style-type: none"> <li>a. Intelligence</li> <li>b. Immediate Memory</li> <li>c. Substitution</li> <li>d. Arithmetic</li> </ol> </li> <li>2. Spatial and Mechanical               <ol style="list-style-type: none"> <li>a. Spatial Relations</li> <li>b. Locations</li> <li>c. Mechanical Principles</li> </ol> </li> </ol> | <ol style="list-style-type: none"> <li>3. Perceptual Accuracy               <ol style="list-style-type: none"> <li>a. Number Comparison</li> <li>b. Name Comparison</li> <li>c. Cancellation</li> <li>d. Pursuit</li> <li>e. Perceptual Speed</li> </ol> </li> <li>4. Motor Abilities               <ol style="list-style-type: none"> <li>a. Tracing</li> <li>b. Tapping</li> <li>c. Dotting</li> <li>d. Finger Dexterity</li> <li>e. Hand Dexterity</li> <li>f. Arm Dexterity</li> </ol> </li> </ol> |
|--|--|

## ASSIGNMENT SHEET 2-3-1A

TITLE

Desoldering Printed Circuit Board Components

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 2.3.1 IDENTIFY the various types of printed circuit solder connections by visual inspection of selected printed circuit boards. Identification will be in agreement with the connection listed in Volume 6 of the PACE Rework and Repair Technology Series.
- 2.3.2 EVALUATE the repair task to be performed and DETERMINE the proper desoldering and component removal method to be used on selected printed circuit boards utilizing information contained in Volume 6 of the PACE Series.
- 2.3.3 DESOLDER various types of printed circuit solder connections using the wicking, manual vacuum and motorized vacuum extraction methods and proper tools necessary as outlined in Volume 6 of the PACE Series.

STUDY ASSIGNMENT

Read and study Notetaking Sheet 2-3-1N of the Student's Guide.

STUDY QUESTIONS

None

## NOTETAKING SHEET 2-3-IN

TITLE

Desoldering and Removing Components

REFERENCES

PACE Rework and Repair Technology Series, Volume 6.

NOTETAKING OUTLINE

## A. Recognition and characteristics of printed circuit solder-joint types

## 1. Common joint types

- a. To recognize the various solder-joint types, you must take into consideration the board circuitry style, the lead termination style, and the style of hole reinforcement.
- b. Of the three considerations, board circuitry style is the easiest to recognize. It consists of the following:
  - (1) A single sided board which has conductors on one side only.
  - (2) A double sided board which has conductors on both sides.



Single Sided



Double Sided



Double Sided, Plated Thru Hole

## BOARD TYPES

- c. The consideration of hole support is generally the hardest to identify because it is often hidden beneath the solder. The various styles of hole support are:
  - (1) No hole support, single sided board
  - (2) Plated-through hole, single sided board
  - (3) Eyelet, single sided board
  - (4) Plated-through hole, double sided board
  - (5) Eyelet, double sided board
  - (6) Fused eyelet, double sided board



Single Sided, Eyeletted



Double Sided, Eyeletted

Double Sided, Plated Thru  
w/ Eyelet

## EYELETS IN DIFFERENT TYPE BOARDS



Flat Set



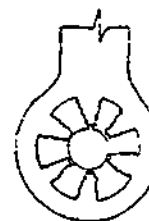
Funnelet



Roll Set



Plain



Petal Set

Any style eyelet may be obtained  
in both head types.

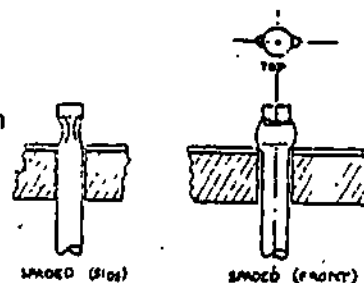
## EYELET TYPES

May be found in any combination of  
head types.

- d. Hole supports normally form "interfacial connections" which are a means of electrically joining the circuitry on double sided boards. The various styles are:
  - (1) Clinched buss wire, soldered on both sides.
  - (2) Any type or style of eyelet, soldered to both sides.
- e. Component lead termination styles
  - (1) A fully clinched lead, a common type often used in machine soldering as well as hand soldering.
  - (2) A semiclinched lead, easier to remove during repair than a full clinch lead.
  - (3) A straight through lead, which provides the greatest degree of repairability.
  - (4) An offset pad termination which has the hole drilled outside of the pad area.
  - (5) A crimped lead on the component side which provides component clearance for improved solvent cleaning and air circulation. This also provides clearance to prevent components with a high operating temperature from scorching the circuit board. Note that this is NOT a lead termination but a component mounting method.



- (6) A spaded lead termination, in which the end of the lead is crimped after being passed through the printed circuit board. NOTE THAT THIS STYLE OF TERMINATION IS EASILY HIDDEN BY THE SOLDER AND THAT THE LEAD MUST BE CUT BETWEEN THE COMPONENT AND THE SPADED PORTION BEFORE ATTEMPTING TO REMOVE THE LEAD FROM THE HOLE.



- (7) A lap solder-joint lead termination is a form or style in which the component lead does NOT pass through the circuit board. Note that a lap joint may be used with both round and flat leads.

## 2. Identification methods

- a. **WARNING:** When indentifying solder-joint types, you are apt to find several different styles of solder-joint construction on a single printed circuit board.
- b. You are also apt to encounter component leads **WELDED** to the printed circuit board pad or run.
  - (1) Welded leads **MUST NOT** be mistaken for solder joints since they **CANNOT** be removed with a soldering iron.
  - (2) The fine black line across the component lead is the identifying characterisic of a welded joint.
  - (3) Any attempt to remove the lead with a soldering iron will damage the board by overheating, without disturbing the weld.
- c. Use the following means to identify board circuitry style:
  - (1) Inspect visually.
  - (2) Use a bright light to backlight the board, if needed, to show the relationship of interconnection paths.
- d. Use the following means to identify lead terminations style:
  - (1) Inspect visually
  - (2) Remove solder from the joint to determine if there are any hidden termination characteristics
- e. Use the following means to identify hole support styles:
  - (1) Inspect visually

- (2) Remove all solder from the connection, CAREFULLY, to determine hidden hole reinforcement characteristics.

B. Desoldering methods for printed circuit solder joints.

1. Removal by wicking.

- a. Solder removal by the wicking method consists of using finely stranded wire (either braided or twisted) in conjunction with liquid flux and heat to cause all but an extremely thin layer of solder to be removed from the joint.
- b. Capillary action causes the solder to be drawn up into the wicking material.
- c. This action is aided by the liquid fluxes ability to increase the wetting action.

2. Manual vacuum extraction.

- a. Solder removal using the manual vacuum method consists of a manually controlled and operated one-shot vacuum source in conjunction with heat to create a vacuum airflow which pulls molten solder from the joint.
- b. Manual vacuum usually has the advantage of instant vacuum rise time (zero to maximum with no delay).
- c. Manual vacuum may have one or more of the following disadvantages:
  - (1) Extremely high vacuum levels which may cause damage by lifting conductors from printed circuit boards, since the conductor bonding material has greatly reduced strength at solder melting temperatures.
  - (2) Inability, in some cases, to apply the vacuum tip and the source of heat to the solder joint at the same time.
  - (3) Short vacuum duration or physical movement of the vacuum tip caused by manual operation of the vacuum source may cause incomplete solder removal, necessitating multiple applications of heat which can result in damage.

3. Motorized vacuum extraction

- a. Solder removal using motorized vacuum consists of a continuous vacuum source such as an airbottle and venturi combination or an electrically driven vacuum pump, which provides a continuous vacuum to a heated solder extraction tip and removes molten solder by vacuum airflow.

- b. Motorized vacuum is normally controlled by a foot-switch and differs from manual vacuum primarily in that it supplies a continuous vacuum.
- c. Motorized vacuum extraction has several advantages:
  - (1) The vacuum can generally be set at the desired level
  - (2) The extraction tip and the heat source are usually combined into one tool.
  - (3) The availability of continuous vacuum allows solder removal with a single application of heat.
- d. Motorized vacuum sources may have a vacuum rise time which is slower than desired.

C. Selection and use of desoldering tools.

- 1. The selection of tools and techniques to be used in a particular desoldering operation will be determined by the type of solder-joint and lead termination.
- 2. The tools and techniques chosen MUST be those least likely to cause damage of any nature. To avoid damage, the following factors should be considered:
  - a. The effect of the chosen technique on the board materials.
  - b. The effect of the chosen techniques on the circuit conductors.
  - c. The effect of the chosen techniques on the adjacent components.

NOTE: Testing and evaluation have shown the following techniques have effective and reliable applications. The technician must decide which technique is best for a specific task, keeping in mind at all times the REQUIREMENT of causing NO damage.

- D. Inferior methods of solder extraction - solder removal methods which should not be used or which have limited applications.
  - 1. The heat and shake method, which should not be used since it does not remove all solder, and it causes solder to be splattered over other areas of the circuit board.
  - 2. The heat and pull method, which should not be used since hidden component lead terminations may cause damage when pulled through the board.

1451

3. The heat and blow method, which should not be used for the same reasons as the heat and shake method.
4. The squeeze-bulb solder extraction method is inferior due to the tip size, incomplete extraction, and frequent solder spillage onto the circuit board.
5. The spring plunger extractor (solder removal) method has limited application since it does not work well in small areas and does not remove all of the solder.

E. Procedures for wicking solder removal

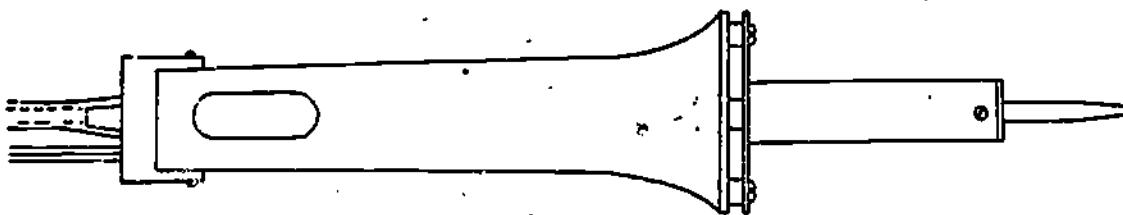
1. Select a piece of wicking material (braid or stranded wire) which is smaller than the area being desoldered.
2. Dip the wicking material in liquid flux and place it on the area to be desoldered, taking care to ensure that there is no overlap of wicking material onto the board material.
3. Apply a clean, dry soldering iron tip to the braid using GENTLE pressure, without moving the tip around on the braid.
4. The wicking material may be drawn across the area to be desoldered after the solder melts and begins to soak into the wicking material.
5. If solder stops flowing into the wicking material before it has all been removed, or if all of the flux is boiled away before removal is complete, the operation must be repeated being sure to cut off the filled portion of the wicking material to provide a fresh wicking area for absorption of solder.
6. Wicking material works progressively better as the number of strands increases and the size of the strands decreases.
7. The following damages can result by improperly using the wicking method:
  - a. Scorching caused by excessive heat and allowing the flux to completely boil away.
  - b. Measles caused by allowing hot wicking material to overlap the pad area and contact the board material.

F. Procedures for manual vacuum solder extractor.

1. Apply the soldering iron tip and the extractor tip to the area to be desoldered at the same time. Note that the space to do this is a limiting factor.

1302P8

2. Upon observing a complete solder melt, press the release trigger which will create a vacuum and cause the solder to be extracted.
  3. The extractor must be firmly held to minimize recoil which may cause the extractor tip to jump away from the joint and result in incomplete extraction and the necessity of repeating the operation several times, with the chance of board damage.
  4. This method will NOT remove 100% of the solder and may cause circuit pad lifting on single-sided boards due to the extremely high vacuum which is generated.
  5. Proper care of this tool to maintain efficient operation requires that it be disassembled and cleaned thoroughly on a regular basis.
- G. The most efficient and versatile of all solder extraction methods is the motorized vacuum method utilizing the "SX 300" solder extractor, which has the following features:
1. In-line extraction path allowing solder to be pulled directly into the solder trap chamber.
  2. Positive locking mechanism for chamber end caps allowing the unit to be used for both vacuum and pressure.
  3. Long thin heating element allowing access to confined areas.
  4. The operator is protected from contact with the hot glass solder trap chamber since it is installed within the plastic handle.



FACE IN-LINE-EXTRACTOR

NOTE: The following procedures or techniques should be utilized with the motorized vacuum extraction method to achieve maximum effectiveness and minimum workpiece degradation.

- H. Motorized vacuum extraction techniques.

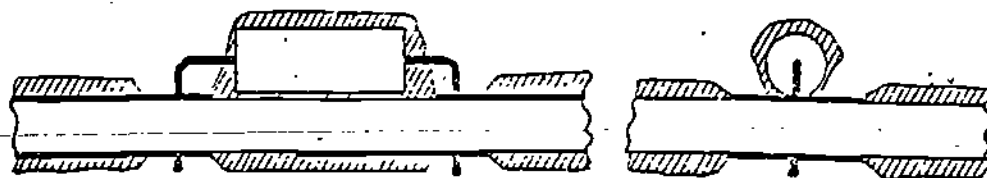
1453

1. The extractor tip must be positioned to allow maximum airflow through the soldered connection for best results. In a dead end hole situation, the majority of the solder is removed with the vacuum and the remainder is blown out with pressure. To prevent sweat joints between component leads and circuit conductors, a stirring motion of the lead with the extractor tip MUST be used.

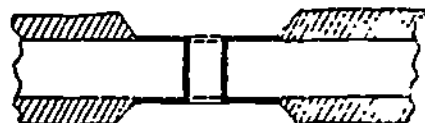
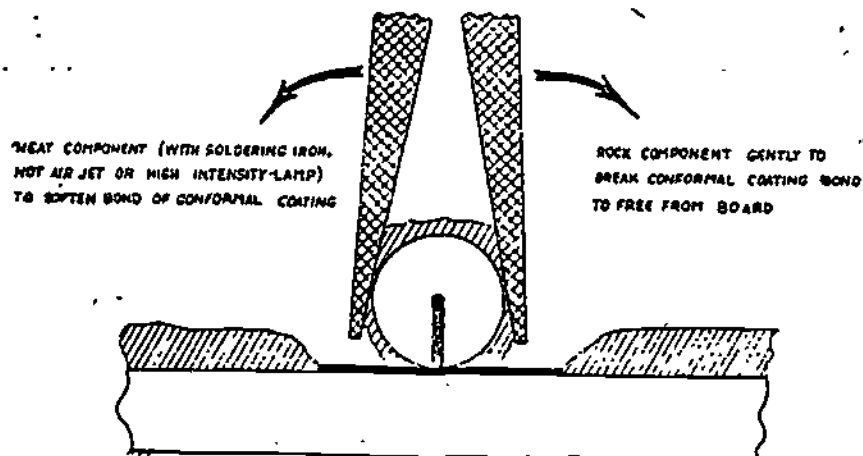
- a. A sweat joint is a paper-thin solder joint formed by the minute amount of solder remaining on the conductor and lead surfaces which cannot be removed by extraction.
- b. To properly prevent sweat joints from forming, the lead must be moved in a stirring motion as soon as the solder has completely melted and before vacuum is applied. The stirring motion must be maintained during the vacuum application and kept up until the airflow has caused the solder to cool and solidify.

NOTE: During the stirring action, the extractor tip MUST NEVER CONTACT ANYTHING EXCEPT THE SOLDER AND THE LEAD ITSELF since contact with circuit conductors will nearly always cause damage.

2. Lead and hole size have several factors affecting solder extraction.
  - a. The amount of space between the lead and the sides of the hole will affect the extraction efficiency by varying the airflow through the hole.
  - b. The depth of the hole will determine the length of time the heat must be applied for a complete solder melt.
3. Both the inside and outside diameters of extractor tips must be considered when selecting a tip.
  - a. The inside diameter is determined by the component lead diameter, which it must fit over.
  - b. The outside diameter is determined by the size and mass of the pad.
  - c. Extractor tips may be modified to fit over various lead terminations, or to fit small, low-mass pads.
    - (1) A ball mill can be inserted inside the tip and used with the rotary tool as a turning and holding device.
    - (2) A file is used to shape the tip to the desired form as it is turning.



EXTRACT SOLDER TO FREE LEADS



1. CLEAN PAD (HOLE AREA THOROUGHLY) ENSURE REMOVAL OF ALL DEAD SOLDER, DIRT AND CONFORMAL COATING
2. CHECK FOR DAMAGE AND NEEDED REPAIRS
3. RE-TRIM PAD(S) PRIOR TO INSTALLING NEW COMPONENT

1455

- d. The exposed copper on the modified tip should be tinned to prevent oxidation and improve heat transfer.

NOTE: The extractor handpiece (element and tip) will attain a temperature of approximately 1,000 degrees at maximum setting of the variable AC control and MUST be used with EXTREME CAUTION. The temperature MUST be properly adjusted for each particular task to avoid causing overheat damage to the workpiece.

I. Component removal procedures after solder extraction are as follows:

1. Straight-through terminations allow the component to be lifted gently from nonconformal coated boards.
2. The various clinched style terminations may require the breaking of a sweat joint which may be done by gripping the lead with pliers or tweezers and rotating the clinched portion approximately 30 degrees PARALLEL to the board surface.
3. After breaking the sweat joint the lead may be lifted gently to a straight position.

NOTE: Do NOT attempt to lift or straighten the lead until the sweat joint is broken.

4. After the component lead is completely free and straight remove the component from a conformal coated board by
  - a. Heating the component with a soldering iron tip or by blowing hot air from the solder extractor (preferred method)

NOTE: Use extreme caution not to cause damage to the workpiece with the heat of this operation.

- b. After any residual coating is softened by heat, grip the component gently with a pair of tweezers or pliers and free it from the coating by a gently side-to-side rocking motion.
- c. At this point the component may be lifted carefully from the board.



- J. Evaluating individual workpieces to determine proper techniques for desoldering and removing components.
1. A careful, thorough physical examination must be made to determine the solder-joint characteristics, most effective desoldering technique, and the tools to be used in applying these techniques.
  2. A careful step-by-step analysis of the task as it is to be performed MUST take into consideration possible hidden characteristics.
- K. Inspecting completed work for damage to the circuit board or to the remaining components.
1. Board damage - check for:
    - a. Scorching or charring caused by component failure or improper repair techniques.
    - b. Measling, which is the appearance of white spots that are small areas of the fiber glass strands which have been exposed by heat, abrasion, or solvent action.
    - c. Possible cracks or breaks in the board material.
  2. Conductor damage - check for:
    - a. Any missing pads or conductors.
    - b. Any nicked or cracked conductors.
    - c. Lifted or delaminated pads or conductors.
  3. Component damage - check for:
    - a. Cracked, broken, or overheated components.
    - b. Deformed or broken component leads.
    - c. Poor solder joints and loose or splashed solder which may cause shorts.
- L. Safety precautions
1. Workpiece
    - a. Never perform any action on the workpiece which will cause damage or degradation.

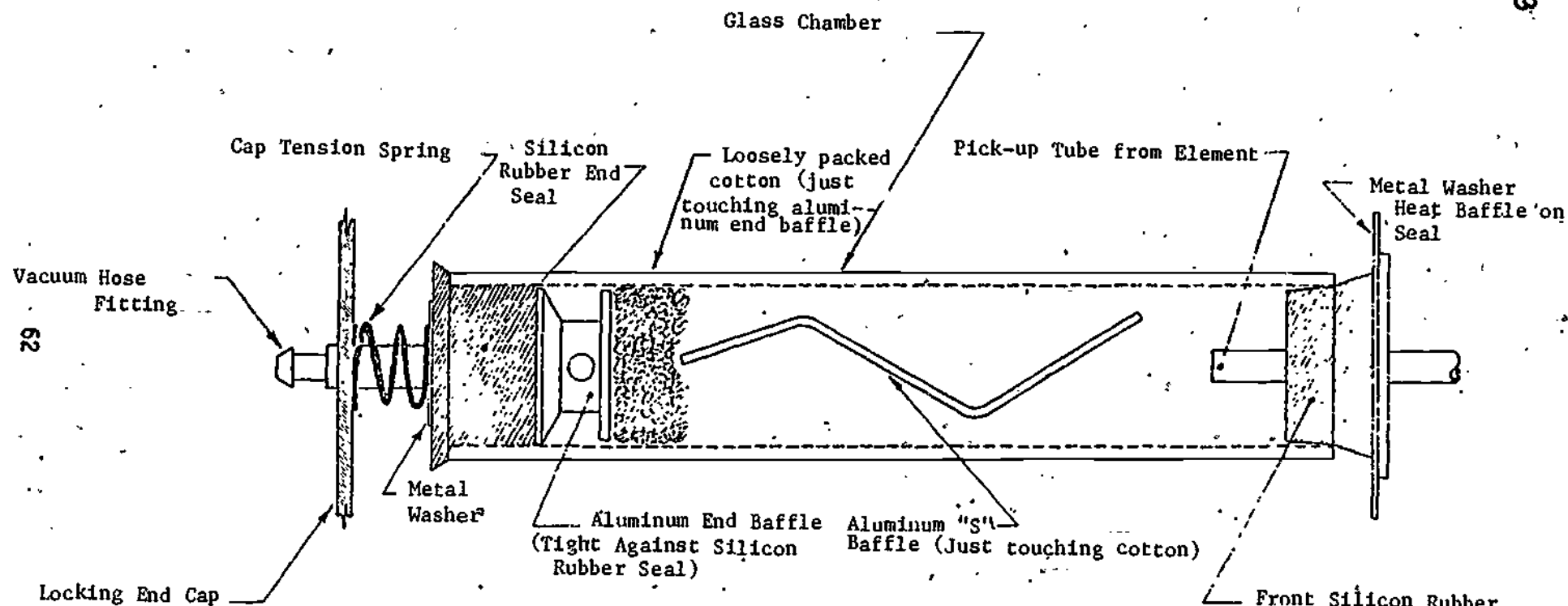
- b. Handle all workpieces as though extremely fragile.
- c. Maintain scrupulous cleanliness at all times.

## 2. Tool

- a. Properly clean all tools and store them in the proper place. Special care is necessary in maintaining the SX-300 Solder Extraction System.
  - (1) Removing the glass chamber - Use a gentle push-turn motion to release the retaining cap, and carefully withdraw the glass chamber to avoid breakage.
  - (2) Cleaning the glass chamber - The large bristle brush is used to clean the glass chamber after carefully pushing out the metal baffle and the cotton vapor trap. A light coating of mineral oil after cleaning will aid in future cleaning.
  - (3) Cleaning the extractor element - The extractor element is cleaned with the small wire brush, after the tip is removed. Cleaning and tip removal must be performed AT LEAST once daily, (or every 8 hours of operation) and the extractor shall be stored with the tip removed.
  - (4) For periodic and unscheduled maintenance of the SX-300 power and vacuum supply refer to the equipment handbook.
- b. Never use excessive force on any tool.
- c. Use each tool only in the manner for which it was designed to be used.
- d. Check all electrical cords daily for damage from hot tools, solvents, or abrasion.

## 3. Personal

- a. Beware of burns from hot tools (keep tools in the holders provided).
- b. Avoid prolonged skin contact and excessive breathing of chemical fumes.
- c. Beware of flammable chemicals and materials.



Note: Aluminum "S" Baffle should be a snug fit in glass chamber, and it must not touch pick-up tube from element!

If allowed to touch pick-up tube, molten solder will be chilled, solidify and block tube. Reducing or stopping vacuum flow to extractor tip. Work-piece damage will result!

Front Silicon Rubber Seal.

Note: Glass chamber must seat or tap seal, or vacuum will be lost (front seal is mounted inside extractor hand piece)

# EXTRACTOR ASSY

1459

1460

## SUMMARY

The results of this review and synthesis of the literature are mixed, depending upon whether one is speaking of the results of predictive studies or classification studies. Regarding predictive types of studies, there are no generalizable criteria that can be used by people selecting and admitting vocational students to optimize student selection and admission for a wide range of vocational programs. This seems to be true, regardless of whether one defines success in terms of training success or job success.

This does not mean it is impossible to develop highly specific sets of criteria to predict success in a specific curriculum within a particular school. The studies conducted at the Los Angeles Trade-Technical College (Crawford, 1966) and findings of other researchers point this out. However, there seems to be little promise that one or two selected and developed instruments could be administered to large numbers of students and used to predict their potential success in a range of vocational programs.

There does appear to be promise, however, for predicting success by using information classification methodologies. These methods would allow students to be compared with people who have been successful in a variety of training programs or occupations, since research has shown that people who tend to be successful in different occupations or training programs do differ in terms of characteristics measured by standardized instruments. Based on these data comparisons, students could be informed about the extent to which they compare favorably or unfavorably to various characteristics typical of successful people in specific training programs or occupations. Although this is possible, some researchers criticize this approach because it is not possible to guarantee that the characteristics that differentiate successful people in different training programs are really those characteristics related to success in the programs. People who select this

## ASSIGNMENT SHEET 2-4-1A

TITLE

Repair of Damaged Printed Circuit Boards

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 2.4.1 IDENTIFY the four categories of damage common to printed circuit boards as identified in MIL-STD-275C and 454D.
- 2.4.2 DETERMINE the extent of repair required and proper repair techniques to be used on any printed circuit board in accordance with information contained in MIL-STD-275C and 454D.
- 2.4.3 REPAIR damaged printed circuit board laminates, conductors and eyelets using the proper tools and techniques and to the standards outlined in MIL-STD-275C and 454D.

STUDY ASSIGNMENT

Read and study Notetaking Sheet 2-4-1N of the Student's Guide.

STUDY QUESTIONS

None

## NOTETAKING SHEET 2-4-1N

TITLE

Repair of Damaged Circuit Boards

REFERENCES

MIL-STD-454D

MIL-STD-275C

NOTETAKING OUTLINE

## A. Types of circuit board damage.

## 1. Four common categories of damage are:

- a. Cracked boards
- b. Scorched, charred or deeply burned boards.
- c. Broken boards.
- d. Delaminated circuit board layers.

## 2. Determining the extent of damage.

## a. Cracked boards

- (1) Length and depth of the crack must be determined by physical inspection.
- (2) Disruption to conductors and components caused by the crack must be determined.
- (3) Care must be taken in examining cracked boards not to cause additional damage.

## b. Scorched, charred or deeply burned boards.

- (1) Determine the area of the board affected by the discoloration of the surface, molten or blackened conductors and burned, melted or blackened components.
- (2) Determine the depth of the affected area which may range from a slight surface discoloration to a gaping hole through the circuit board.

## c. Broken boards

- (1) Determine if all parts of the board are present.
- (2) Determine if circuit conductors or components have been affected by the break.
- (3) Determine if the broken pieces may be rejoined RELIABLY or if new pieces must be manufactured.

## d. Delaminated circuit board layers.

- (1) Determine the area of delamination.
- (2) Determine if the circuit conductors or components have been affected by the delamination.

NOTE: This type of damage, unless occurring in a limited area, is beyond the capabilities of field tools and techniques and required manufacture of a new board laminate (possibly using conductors and components off the damaged board).

## 8. Circuit board repair techniques.

## 1. Patching

- a. Damage which does not extend completely through the board may be repaired by the patching technique.
- b. The patching technique consists of the following steps:
  - (1) If the board is scorched, charred or burned, remove all discolored board material, including any measles, by abrasive methods.
  - (2) Repairable delaminations which do not extend to the edge of the circuit board should be cut away by abrasive methods until no delaminated material remains.
  - (3) Do not remove delaminated material if a repairable delamination exists which extends to the edge of the printed circuit board.
  - (4) After removing all damaged board material, level and/or undercut the edge of the removed area to provide physical holding points for the repair material.
  - (5) Clean thoroughly with solvent to remove all loose particles.
  - (6) Mix a compound of epoxy and powdered fiber glass and fill the cutaway area with this compound, being EXTREMELY careful to leave no voids or air bubbles.

- (7) Level the surface of the filled-in area being sure that the surface of the fill material is no lower than the original board surface.
- (8) In the case of delaminations on the edge of the board, fill the delaminated layers COMPLETELY with the repair mixture and clamp firmly together between two flat surfaces.
- (9) Cure the epoxy repair mixture completely as per the manufacturer's instructions found on the package.
- (10) After cure is completed, smooth the repaired surface to the same level as the original board using abrasive methods.
- (11) If necessary, redrill any holes which existed in the damaged area and clean the repair thoroughly.

## 2. Rebuilding

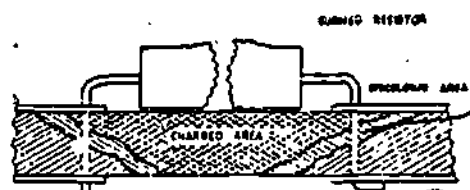
- a. Damage which extends completely through the board, such as cracks, breaks and holes, must be repaired using rebuilding techniques.
- b. Cracks are repaired using the following steps:
  - (1) Remove all chips and fractured material using abrasive methods.
  - (2) Level and under cut the edges of the removed area to provide NEEDED physical bond strength.
  - (3) Fasten a smooth surface tightly against one side of the removed area.
  - (4) Using clamps fasten the board firmly and immovably, keeping any loose pieces in proper alignment and with the uncovered side of the repair area up.
  - (5) Mix a compound of epoxy and powdered fiber glass and fill the cutaway area with this compound, being extremely careful to leave no voids or air bubbles.
  - (6) Level the surface of the filled-in area being sure that the surface of the fill material is no lower than the original board surface.
  - (7) Cure, smooth, redrill and clean as in the patching method.



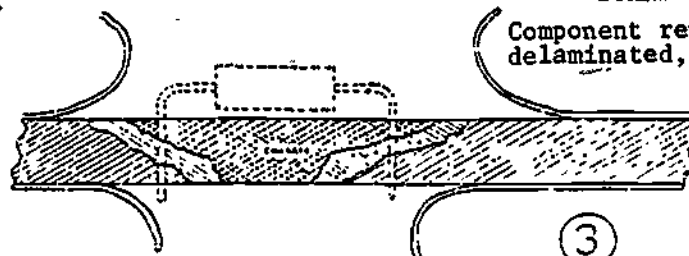
- c. Breaks and holes are repaired in the same manner as cracks unless broken pieces are missing or the hole exceeds 1/2 inch in diameter, in which case the following repair steps are used.
- (1) Using the same technique as with crack repair, prepare the damaged edge.
  - (2) Using a scrap board of the same type and thickness, cut a piece that duplicates as nearly as possible the missing area. Prepare the edges of this cut piece in the same manner as the edges of the hole were done.
  - (3) Tightly fasten a smooth surface over one side of the repair area and firmly clamp the board in an immovable position with the uncovered area up.
  - (4) Position the replacement piece as nearly as possible to duplicate the original board configuration. Firmly clamp the replacement piece in place.
  - (5) Complete the repair using the same epoxy-fiber glass mixture and repair techniques as in the patching repair method.



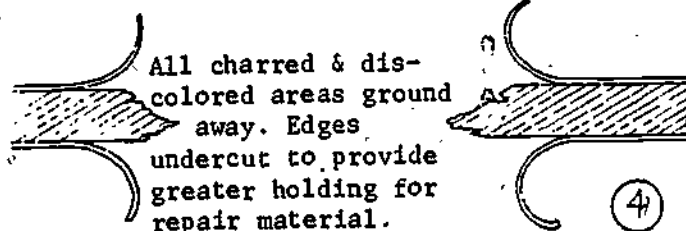
Area of board damaged by failure of component.



CUTAWAY VIEW, DAMAGED BOARD

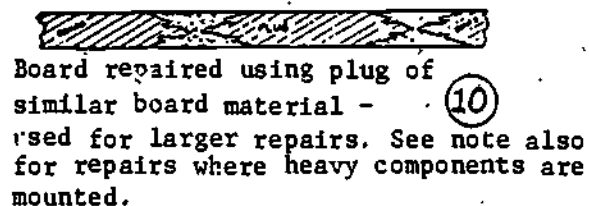
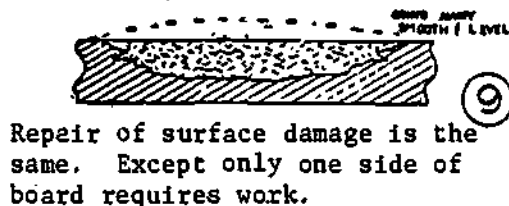
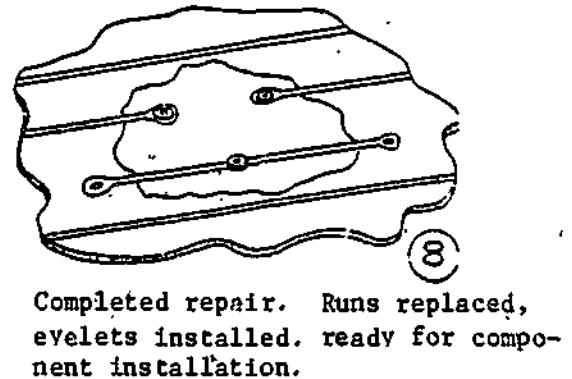
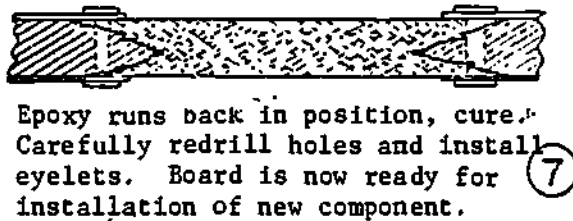
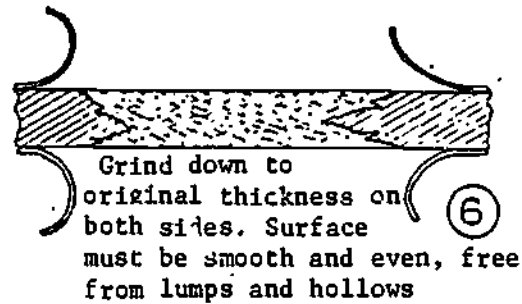
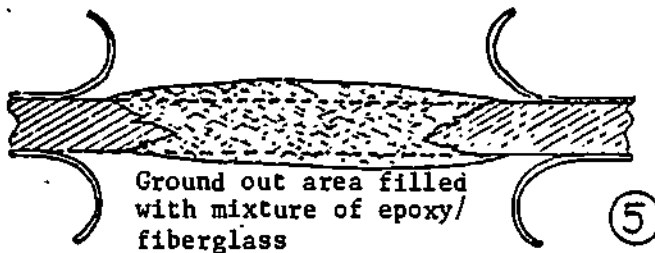


Component removed - Conductors delaminated, laid back out of the way.



All charred & discolored areas ground away. Edges undercut to provide greater holding for repair material.





C. Types of printed circuit run and pad damage are:

1. Cracked conductors

- a. Cracks in conductors may be partially or completely through the conductor.
- b. Crack damage which includes nicks and scratches in the conductor must be repaired if it exceeds one-tenth of the cross-sectional area of the conductor.

2. Missing conductors

- a. In this type of damage, pads or conductor runs are completely missing from the board.
- b. Also included in this type of damage are conductors that are present but physically damaged to a point beyond repair.

### 3. Delaminated conductors

- a. Delaminated conductors are those which are no longer bonded to the board surface.
- b. The delamination may occur at any portion of the conductor.

### D. Printed circuit run and pad repair techniques.

#### 1. Crack repair

- a. Cracks in printed circuit conductors are repaired using the following techniques.
  - (1). One method of repair is to flow solder across the crack, forming a "solder bridge". This is not a high-reliability repair (since the solder in the break will crack easily) and should be used only when no other technique can be used.
  - (2) Another method of repair is to lap solder the crack. This method is somewhat stronger than a solder bridge, but still is not highly reliable as it is also subject to solder cracking.
  - (3) A third repair technique is to drill a hole through the board where the crack is (always drill the hole smaller than the width of the run), then install an eyelet in the hole and solder it in place.
  - (4) The clinched staple method of crack repair is the most reliable and may be used in nearly all cases. Care must be taken when using this technique not to drill the holes through conductors and components on the other side of the board, and to use insulated wire if the wire crosses other conductors or leads.

#### 2. Conductor and pad replacement

- a. Damaged or missing conductor replacement.
  - (1) To replace sections of conductors, cut away the badly damaged portion, if present, and drill a small hole through the remaining conductor at each end of the break. Do not drill the hole through conductors on the opposite side of the board.
  - (2). Use a wire jumper to replace the missing conductor. Insulated wire must be used to prevent shorts if the jumper crosses other conductors.

(3) The replaced section is placed on the opposite side of the board to provide maximum physical strength.

(a) This type of repair is merely an elongated version of the clinched staple.

(b) The reliability of the repair may be increased even more by installing an eyelet in each of the holes before installing the jumper.

### 3. Missing pad repair.

a. Obtain a replacement pad from a scrap circuit board.

b. Clean the replacement pad and the area where it will be installed.

c. Epoxy the replacement pad to the board.

d. Reinforce the pad by installing an eyelet before the epoxy sets and cures.

e. After the epoxy cures, lap solder the pad to the original run.

f. For maximum reliability, the conductor edges should be beveled before installation. As an alternate to beveling a matching spacer pad may be positioned on the board and the replacement pad lap soldered to both it and the conductor after epoxying the pads to the board and installing an eyelet through both pads.

### 4. Conductor bonding

a. Mix a small amount of epoxy and apply it to the conductor and the conductor path, leaving no uncoated areas.

b. Clamp the conductor firmly against the board surface until the epoxy has completely cured.

c. If the lifted area is at the end of a conductor, it may be eyeletted immediately after the epoxy is applied.

## E. Techniques for replacing damaged printed circuit eyelets.

### 1. Selecting

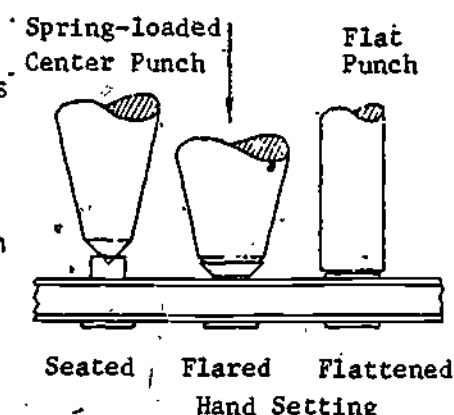
a. The eyelet must be approximately 1/32 inch longer than the board thickness.

b. The inside diameter of the eyelet must be just large enough to allow the lead to pass through it freely without binding.

- c. The hole must not be drilled at an angle.
- d. When replacing an eyelet where one previously existed, the drill bit should be the same as the original hole and the eyelet should be picked to fit the hole size.
- e. When drilling to install an eyelet where none previously existed, be sure to examine both sides of the board and determine that no conductor damage or shorting will be caused by the eyelet installation.

## 2. Setting

- a. The first step in setting an eyelet is to brace the preformed head of the eyelet against a flat, solid surface such as a jewelers anvil.
- b. The unformed end of the eyelet is then flared to an approximate 45 degree angle by punching the end with an adjustable spring-loaded automatic center punch.



- c. The punch is adjusted for proper striking force by setting a practice eyelet on a scrap circuit board.
- d. The flared end is set flat by tapping a flat pin punch GENTLY against the flared end with a soft faced hammer. A single tap should be sufficient to properly set the eyelet.

## 3. Soldering.

- a. After setting, the eyelet must be soldered to the circuit conductor for highest reliability.
- b. If a lead or wire is to be soldered through the eyelet the lead and eyelet should both be soldered in a single operation.
- c. Pretinning may be required depending on the eyelet material and/or plating.

## F. Evaluating damaged printed circuit boards to determine the extent of repair necessary and the repair techniques to be used.

### 1. Determining board construction.

- a. The following major characteristics must be properly evaluated to determine the overall construction of a circuit board:

(1) Type of circuit baseboard material.

(2) Circuit conductor style.

- (3) Component types
  - (4) Component mounting style
  - (5) Type of lead termination
  - (6) Type of interfacial connection
  - (7) Solder-joint type
  - (8) Type of conformal coating
2. Determining the type and extent of damage.
- a. The type of damage is determined by the portions of the assembly which are affected. The most common types are:
    - (1) Component damage
    - (2) Coating damage
    - (3) Conductor damage
    - (4) Baseboard damage
  - b. The extent of damage is determined by the nature of the damage to each individual portion of the assembly.
    - (1) Coatings may be peeled, burned, charred or dissolved.
    - (2) Conductors may be cracked, broken, delaminated or missing.
    - (3) Baseboards may be cracked, broken, delaminated, charred, burned or have pieces missing.
3. To evaluate the feasibility of repair, ask:
- a. Is reliable repair possible with the available tools and techniques?
  - b. Can the board be salvaged at the expense of destroyed components?
  - c. Can the components be salvaged when the board is not repairable?
  - d. Is reliable repair possible at a higher maintenance level (micro-miniature repair specialist)?

1470

4. Choosing the appropriate repair techniques.
  - a. After completely evaluating the repair task to be performed, establish a step-by-step repair procedure.
  - b. Choose the available tools and techniques which will most reliably complete the steps of the repair procedure.
5. Inspecting repaired printed circuit boards for completeness and quality of repair.
  1. Condition of the laminate.
    - a. Inspect the laminate material for any unrepaired damage.
    - b. Inspect the laminate repairs for quality and reliability.
  2. Condition of the conductors
    - a. Inspect the conductors for any unrepaired damage.
    - b. Inspect the conductors repaired for quality and reliability.
  3. Condition of the eyelets
    - a. Inspect the eyelets for any unrepaired damage.
    - b. Inspect eyelet repairs for quality and reliability.
- H. Safety precautions
  1. Workpiece
    - a. Never perform any action on the workpiece that will cause damage or degradation.
    - b. Handle all workpieces as though extremely fragile.
  2. Tool
    - a. Never use excessive force on any tool.
    - b. Use each tool only in the manner it was designed to be used in.
  3. Personal
    - a. Use eye protection when using power tools and when there is a chance of splashing chemicals.
    - b. Do not breathe dust particles from cutting and grinding operations.
    - c. Beware of burns from hot tools

## ASSIGNMENT SHEET 3-1-1A

TITLE

Soldering to Turret Terminals

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 3.1.1 PREPARE turret terminals for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.
- 3.1.2 PREPARE wires for soldering by stripping, tinning and bending following the procedures and to the standards outlined in MIL-S-45743C.
- 3.1.3 CONNECT prepared wires to turret terminals using the proper tools and soldering techniques following the procedures to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4(3A).

STUDY ASSIGNMENT

Read and study Notetaking Sheet 3-1-1N of the Student's Guide.

STUDY QUESTIONS

None



## NOTETAKING SHEET 3-1-1N

TITLE

Hand Soldering Turret Terminals

REFERENCES

MIL-S-45743C  
MIL-STD-454D  
NHB 5300.4 (3A)

NOTETAKING OUTLINE

## A. Types, sizes and usage of turret terminals.

## 1. Common types

- a. Those designed to protrude from one side of the mounting surface only.
  - (1) Single section
  - (2) Multiple section
- b. Those designed to protrude from both sides of the mounting surface (feed-through types).
  - (1) Single section
  - (2) Multiple sections
  - (3) Combinations

## 2. Common sizes

- a. Turret terminals are used in many sizes.
- b. The terminal size and conductor size should match.
- c. The procedure of placing a large component or conductor on a small terminal creates undesirable stresses on the terminal which may lead to unreliability of the assembly.

## 3. Uses - Turret terminals are used for the following:

- a. For providing interfacial connections on printed circuit boards.
- b. As terminal points for point-to-point wiring.
- c. For mounting components.
- d. As tie points for interconnecting wiring.

## B. Preparing turret terminals for soldering.

### 1. Cleaning

- a. Terminals must be cleaned prior to attaching leads or conductors. Cleaning may be done by:
  - (1) Adding, then removing new solder from the terminal surface, thus removing oxides.
  - (2) On new, relatively clean terminals, the use of solvent is often sufficient. If not, then the above method should be used.
  - (3) Old, used, very dirty, or highly oxidized terminals may require repeated solder coating/removal steps and/or abrasive techniques to properly prepare them for soldering.
- b. If the terminals must be handled after cleaning operations, a recleaning with solvent is necessary to remove the oils and salts deposited from contact with the skin.

### 2. Tinning terminals

- a. Terminals must be tinned prior to soldering. This enhances the flow of solder and aids in the formation of a reliable intermetallic bond.
- b. The solder coating/removal steps involved in the cleaning process provide a good tinned surface.
- c. For tinning a new terminal, the application of flux and fresh solder with the proper heating to cause the solder to wet thoroughly is required.

## C. Preparing wire for soldering to turret terminals.

### 1. Tools used

- a. Mechanical and/or thermal wire strippers.
- b. Soldering iron.
- c. Antiwicking tools (tweezers, "Little Joes", etc.).
- d. Vise
- e. Round nose pliers
- f. Nylon rod/orangewood stick.
- g. Flush-cutting pliers
- h. Soldering iron holder.

1474

## 2. Insulation removal

- a. The wire is stripped CAREFULLY, using either an approved style of mechanical wire stripper or the thermal strippers (chemical stripper for varnish).
- b. Only mechanical strippers of the nonadjustable, factory set type should be used when thermal strippers are not available. Other types such as the old "Miller" strippers and the combination stripper, crimper and boltcutter are NOT approved.
- c. The nonadjustable, factory set strippers have precision blades to provide reliable stripping without damage when used with care.
- d. These strippers should be inspected frequently to ensure that the blades are sharp and have not become misaligned.
- e. Mechanical strippers should not be used on wire sizes AWG-22 or smaller. The mechanical advantage of the stripper is such that the smaller sizes mentioned may be stretched by the pulling action of the stripper as the insulation is removed.
- f. Any damage to the wire caused by stripping (cuts, scrapes, nicks, or "birdcaging") is grounds for rejection. The damaged area shall be removed and the wire restripped.
- g. Thermal strippers, utilizing a controlled melting action, should be used whenever possible as the chance for wire damage is minimized.
- h. The wire is inserted into the jaws of the thermal strippers. Some models have an adjustable stop to provide a repetitive strip length, and some have an adjustment for depth of jaw cut.
- i. In operation, the jaws are closed GENTLY on the wire and power is applied. The wire is then turned approximately 90 degrees when the melting action becomes visually apparent.
- j. When the jaws have melted through the insulation creating a cut completely around the circumference of the wire, the jaws are opened and the wire removed. The action desired is to MELT through the insulation, NOT to burn through. Burning will damage the insulation and cause rejection of the wire.

- k. Remove the insulation with your fingers. The insulation must be allowed to turn and follow the lay of the wire strands during this operation to prevent birdcaging of the wire. DO NOT change the rate of twist of the wire in the stripping process. The wire strands should not be disturbed.
- l. Chemical stripper is used to remove varnish type insulation from motor/magnet wire.
  - (1) Dip the wire in the chemical
  - (2) Allow three minutes for softening
  - (3) Use a disposable tissue (kimwipe) to clean the softened varnish off of the wire.
  - (4) Neutralize the exposed wire with water or a solvent to prevent the chemical from damaging the remaining insulation.
3. Tinning the wire
  - a. Tinning of the wire is required to prevent damage in the bending operation and to enhance the flow of solder during the soldering operation.
  - b. The use of antiwicking tweezers to prevent solder wicking up under the insulation due to capillary action is recommended.
    - (1) The operation is performed by bringing a clean dry soldering iron in behind the wire, one third to one half the distance down from the antiwicking tool.
    - (2) Solder is applied at the junction of the iron and the wire, and allowed to soak into the wire.
    - (3) The iron and solder are then moved up the wire toward the antiwicking tool.
    - (4) When the iron and solder reach the antiwicking tool, hesitate momentarily and continue to flow in solder, then work back down and off the end of the wire carrying any oxides removed by the flux off the wire.

1476

c. Alternate method of tinning wire.

- (1) Melt fresh solder on the clean dry tip.
- (2) Lay the wire into the molten solder while adding solder to the top of the wire.
- (3) When the solder is seen to soak into the wire, move the wire in the same manner as in the previous method of tinning, hesitating next to the antiwicking tool, then back the wire through the solder until the cut end is reached and then off the iron.

d. For best results in tinning, the iron must be at full line voltage. A flat faced tip should be used.

4. Bending

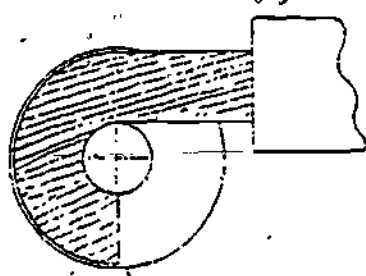
a. Any method may be used for bending that does not damage the wire in any way.

- (1) Round nose pliers
- (2) Nylon rod/orangewood stick
- (3) Dummy terminal

D. Turret terminal solder connection specifications.

1. Wire wrap

- a. In all cases for turret terminals, the minimum wrap around the terminal shall be 180 degrees (one half turn).
- b. Maximum amount of wrap depends on the wire size.
  - (1) AWG-26 and smaller may be wrapped up to 360 degrees (one full turn).
  - (2) AWG-24 and larger may be wrapped up to 270 degrees (three fourths of a turn).
- c. The preferred wire wrap is 180 degrees for all sizes of wire.



Minimum  
allowable  
Preferred

Maximum  
270°  
#24 (Larger)

Maximum  
360°  
#28 (Smaller)



Degree shown from  
1st point of  
contact

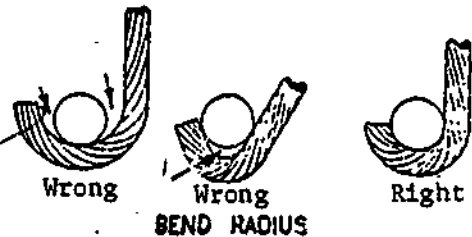
TURRET TERMINAL WIRE WRAP

5274P7

Cut end of wire  
should be even with center  
of post, bend radius same  
as radius of post (Snug fit) 79

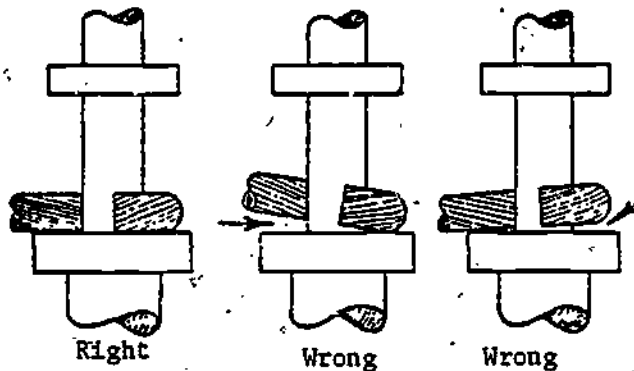
1477

- d. The size of the bend made shall be such that the bend will fit firmly against the terminal post throughout the entire wrap, and cover a minimum of 180 degrees.

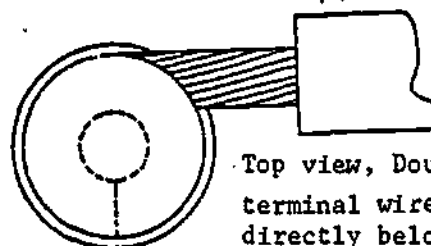
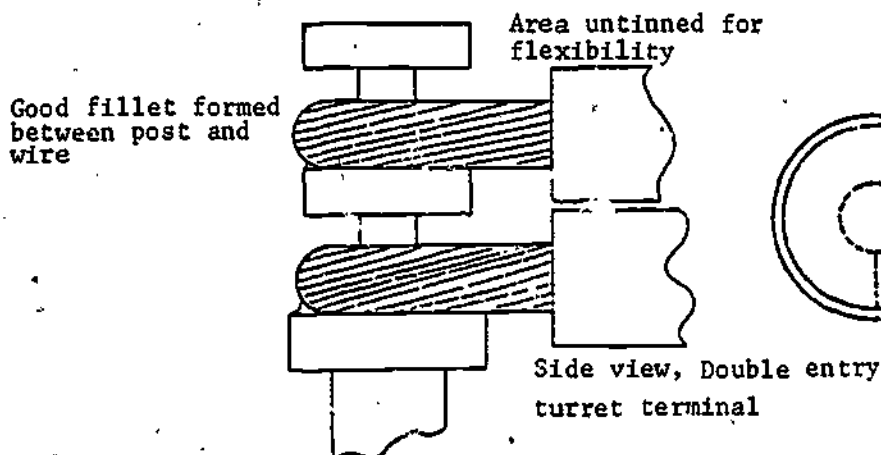


## 2. Wire position

- a. Proper position of the wire on the terminal requires that it be set firmly against the post portion of the terminal and that it be set flat on the pad area as viewed both from the front and side.



- b. Wire holding devices may be used to hold the wire in position and to prevent motion while soldering.
- c. Wire positioning requirements are the same for two or more wires as they are for single wire connections with the following additional requirements:
- (1) All wires are wrapped in the same direction.
  - (2) All wires are trimmed to the same lengths.
  - (3) Wires are positioned directly one above the other.



Top view, Double entry turret terminal wire: Bottom wire directly below top wires.

1478

- d. In field operations any method that will hold the wire may be used, such as the use of rubber bands, clips, etc.

3 Area to be soldered.

- a. The area to be soldered consists of the pad portion of the terminal, the post portion of the terminal and the area of the wire in contact with the terminal.
- b. Where cutting the bent wire leaves copper exposed, the soldering operation must ensure that no copper remains exposed.

4. Solder quantity

- a. Solder quantity shall be such that all angles formed by the junction of the wire and the terminal will be filled with solder to form a fillet.
- b. Overall flow of solder shall present an appearance of concave fillets extending approximately one half the way up the wire.
- c. The contour of the wire strands shall be visible.
- d. There shall be no convex appearance to the solder flow on the finished terminal.

E. Tools used to make turret terminal solder connections.

1. Handtools

- a. Vise
- b. Antiwicking devices
- c. Wire securing devices

2. Power tools

- a. Soldering iron
- b. Variac

F. Techniques for making high quality turret terminal solder connections.

1. Application of flux.

- a. Flux cored solder normally supplies all necessary flux for proper wetting of solder.
- b. External flux may be used; however, the possibility of causing the solder to wick under the insulation is high.

## 2. Proper heat

- a. Proper heating is required to bring the terminal and wire mass RAPIDLY to the melting temperature of solder.
- b. Proper heating is accomplished by using the appropriate size tip and the appropriate wattage element for the size of mass involved.
- c. A solder bridge accomplishes rapid transfer of heat from the iron tip to the connection.

## 3. Application of solder

- a. For proper application of solder, bring a clean, dry iron into contact with BOTH the terminal and the lead.
- b. A heat bridge should be established between the iron and the lead with clean solder.
- c. At this time, place the solder at the end of the wire to tin the exposed copper, and also form the fillet between the start of the wire bend and the terminal where the wire enters the terminal.
- d. These fillets are formed by wiping the solder across the end of the wire and continuing across the pad portion of the terminal and into the angle formed by the incoming wire and the post.
- e. When the proper amount of solder has been applied, remove the solder and the iron at the same time. This will prevent overheating the solder and result in a smooth, gleaming finish.

## 4. Cleaning after soldering.

- a. After the solder connection has cooled and the solder has solidified, the connection must be thoroughly cleaned with an approved solvent to remove all traces of flux and/or dirt.

## G. Inspecting completed turret terminal solder connections for quality and reliability.

### 1. Standards of acceptance

- a. The insulation gap shall be no greater than a distance equal to two times the overall diameter of the wire, including the insulation, measured from the insulation to the edge of the terminal where the wire first makes contact.
- b. The preferred insulation clearance for turret terminals is one overall wire diameter.



- c. The wire shall be confined to the guide slots.
  - d. The wire shall be flat on the pad portion of the terminal.
  - e. The bend of the wire shall fit snugly against the post.
  - f. The solder shall have a smooth gleaming finish free from holes, pits and stress lines.
  - g. The solder shall show no evidence of dewetting from either the terminal or the lead.
  - h. The contour of the wire strands shall be visible and the solder flow shall present concave fillets.
  - i. The insulation shall show no signs of overheating such as swelling or discoloration; nor shall it be imbedded in the solder joint.
  - j. There shall be no wicking of the solder under the insulation. This provides the required flexibility at the connection to prevent vibration and stresses from causing the wire to break at this point.
  - k. There shall be no spillage of solder over the sides of the terminal (a thin wetted area is acceptable).
  - l. Inspection of the terminal for quality involves all of the standards of acceptance.
2. Reasons for rejection.
- a. Many reasons exist for rejection of a turret terminal connection:
    - (1) Broken wire strands.
    - (2) Discolored insulation.
    - (3) Wire not properly positioned on the terminal.
    - (4) Overheated solder.
    - (5) Disturbed solder.
    - (6) Wicking.
    - (7) Scraped spots on the terminal.
    - (8) Pits in the solder.

(9) Dewetting.

(10) Nicked strands.

H. Safety precautions.

1. Workpiece

a. Never perform any action on the workpiece which will cause damage or degradation.

b. Maintain scrupulous cleanliness at all times.

2. Tool

a. Clean and store all tools properly.

b. Never use excessive force on any tool.

c. Use each tool only in the manner for which it was designed to be used.

3. Personal

a. Beware of burns from hot tools.

b. When using chemicals beware of skin, eye and internal contact, and avoid excessive inhalation of fumes.

c. Teflon releases toxic fumes at 400 degrees F. Be especially careful when thermally stripping wire as the element of the stripper exceeds 400 degrees and will cause fuming of Teflon insulation.

d. Use eye protection when there is a danger of splashing chemicals.

e. Avoid any possibility of igniting flammable chemicals or materials.

## INFORMATION SHEET 3-I-II

TITLE

## Electrical Wire Splicing

INTRODUCTION

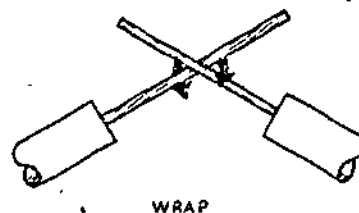
Electronics personnel have long needed training and standardized methods for making reliable wire splices. This has been particularly true in the field of miniature/micro-miniature repair where many wires that are highly susceptible to damage are used. The information section below explains four reliable methods of splicing wires in electronic equipment.

INFORMATION

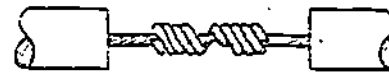
Wire preparation is as important in splicing as it is in any other soldering operation. Preparation consists of stripping the insulation off of the wire, and tinning the strands to prevent damage during the making of the mechanical portion of the splice. Stripping and tinning techniques for splices are the same as those for any other use of stranded wire, except that one type of splice, the mesh splice, requires that the wire NOT be tinned.

The mechanical connection is very important in providing strength in a splice.

1. The wrap splice is mechanically prepared by laying two tinned wires across each other in an "X" pattern and wrapping them around each other two or three times with a twisting motion of the fingers. To give proper strength and reliability both wires must twist (not one straight wire with the other wrapped around it). The twisted portion should be tight, with the cut end of the wire flush cut and not sticking out from the splice.



2. The hook splice forms the strongest mechanical connection, but it also makes the largest diameter splice, which is often undesirable. Also, this type of splice will require a long section of tinned wire. The splice is formed by making a "J" bend in each of the two tinned wire ends and linking the hooks together, with each wire then wrapped back around itself. The cut end of the wire must be flush cut, and not sticking out away from the rest of the splice.



WRAP SPLICED

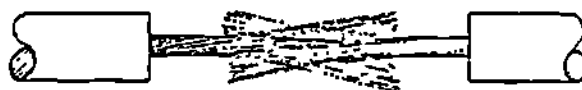


HOOK SPLICED



Strip and Spread Ends

3. The mesh splice has the smallest diameter and is the most flexible splice, but it also provides the least mechanical strength. This is the type of splice that doesn't use tinned wires, which is often an advantage. To form the mechanical connection, first fan the wire strands of both wires out into a cone shape. The wires are then pushed straight into each other so that the strands interlace evenly, without bunching. Finally, the wires are gripped gently with the fingers and twisted in such a manner as to approximate the original wire lay. This type of splice CANNOT be used for double twisted wires. The reason for this is that the double twisted wire has an inner core of strands that are wrapped opposite of the lay of the outer layer of strands. The inner core of strands will normally not fan out into the cone shape needed for the mesh splice.

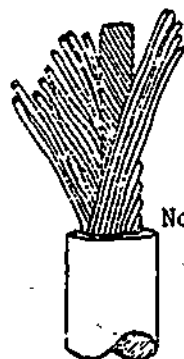


Work Ends Together Evenly



Re-twist

Work Ends in Evenly, Smoothly

Double Twist Wire  
(High Strength, Flexible)

Note: Cannot be used for  
"Mesh" Splices

The solder connection is also important in making splices. The specifications for the three previous splices are the same as those for soldering any wire. The splice must have smooth concave fillets formed at all areas of contact between the wires. The individual strands must be clearly visible through the solder, with NO wicking or heat damage to the insulation.

A relatively new device for making splices is the solder-filled shrinkable splice. These splices consist of a piece of shrinkable tubing with two pre-formed solder rings inside. To use this type of splice, insert two properly stripped and tinned wires into the splice from opposite ends so that the ends of the wires are beside each other. The splice is then shrunk by applying hot air from a heat gun (or the solder extractor in the hot air jet mode). The hot air will cause the solder rings to melt and make the soldered splice while simultaneously shrinking the sleeve to re-insulate the spliced area. This method is quick and reliable, but there is no mechanical connection between the wires and the splice can be pulled apart if subjected to stress.

1484

The use of some type of insulation is mandatory if the splicing of a wire leaves an uninsulated area. Heat shrinkable tubing is the best method of insulating this area. The size of tubing used should be such that it will firmly seal over the original insulation when fully contracted, but not so tight that it will present a danger of splitting when the wire is flexed. Remember to always place the sleeving onto the wire before making the solder connection. Also, the tubing should never be positioned over the splice area until the solder connection has been thoroughly cleaned and inspected. The only reliable method of shrinking tubing is with the use of hot air since other methods (such as a soldering iron tip or open flame) are very likely to cause damage. A heat gun is satisfactory for most average size connections, but in micro-miniature repair the most reliable tool has been found to be the solder extractor used in the hot air jet mode, because the heat can be localized to a very minute area. When shrinking tubing, take care not to concentrate too much heat in one spot, by not keeping the source moving the whole time heat is being applied. Too much heat is worse than not enough, as it will cause the tubing to lose some of its insulating properties.

As for any other solder connection, the soldered splice must be inspected. Check that all specifications and standards of soldering have been met, including solder finish, wetting, quantity, no defects, and no wicking or insulation damage. After installing shrinkable tubing, inspect it to insure it is properly installed, and that there are no damages to the tubing. For solder filled shrinkable splices check that the solder rings have completely melted, the insulation has shrunk completely, and that there is no wicking of the wires.

#### SUMMARY

The wrap splice is reliable and relatively easy to make, as it requires that the wires only be wrapped around each other. The hook splice is mechanically stronger, but is more difficult to make since it has the wires wrapping back on themselves. The mesh splice is the easiest to make, but is the weakest of the splices, and should not be used where there is stress involved. Solder filled shrinkable splices are easy to make if you have a hot air source, but again, there is no mechanical connection and this type of splice may pull apart if subjected to a pulling stress.

## ASSIGNMENT SHEET 3-2-1A

TITLE

Soldering to Hook and Pierced Tab Terminals

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 3.2.1 PREPARE hook and pierced tab terminals for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.
- 3.2.2 PREPARE wires for soldering by stripping, tinning and bending following the procedures and to the standards outlined in MIL-S-4743C.
- 3.2.3 CONNECT prepared wires to hook and pierced tab terminals using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 53D0.4(3A).

STUDY ASSIGNMENT

Read and study Notetaking Sheet 3-2-1N of the Student's Guide.

STUDY QUESTIONS

None

## NOTETAKING SHEET 3-2-1N

TITLE

Hand Soldering Hook and Pierced Tab Terminals

REFERENCES

MIL-S-45743C  
MIL-STO-4540  
NHB 5300.4 (3A)

NOTETAKING OUTLINE

- A. Types, sizes, and usage of hook and tab terminals.
  - 1. Common types
    - a. Hook (question mark style)
    - b. Hook ("J" style)
    - c. Tab (pierced tab eyelet)
  - 2. Common sizes
    - a. Many sizes are used depending on the current flow requirements of the device.
    - b. Terminal size and wire size should correspond.
  - 3. Uses
    - a. Hook and tab terminals are used to provide connection points on sealed devices and terminal boards.
    - b. Tab terminals are usually connection points on the rear of edge connector receptical pins.
    - c. When this type of terminal is used, the connections are normally made in an end-on manner.
- B. Preparing hook and tab terminals for soldering.
  - 1. Terminals must be cleaned prior to attaching leads. Use the same procedures as with turret terminals.
  - 2. Terminals should always be tinned prior to soldering.

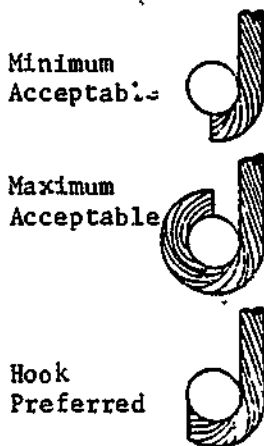
C. Preparing wire for soldering to hook and tab terminals.

1. Stripping the wire requires the same techniques and procedures as used with turret terminals.
2. Tinning the wire requires the same techniques and procedures as with turret terminals.
3. Bending
  - a. Any method may be used for bending the wire that does not damage the wire in any manner.
  - b. Care must be taken not to crush, overstress, or birdcage the wire during the bending operation.

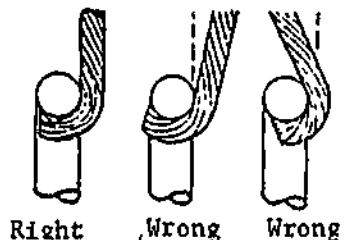
D. Hook and tab terminal solder connection specifications.

1. Wire wrap

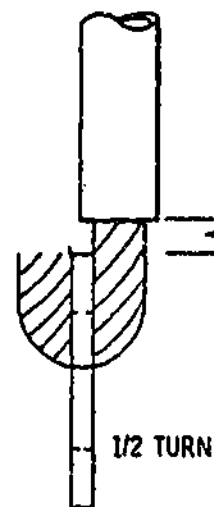
- a. In all cases, for hook and tab terminals, the minimum wrap around the terminal shall be 90 degrees ( $1/4$  turn).
- b. The maximum wrap shall be no more than 270 degrees ( $3/4$  turn).
- c. For hook type terminals the recommended wrap is 120 degrees.
- d. The cut for 120 degrees is not straight across the wire but cut on an angle to form a flush surface with the terminal when installed.
- e. For tab type terminals the recommended wire wrap is 180 degrees. The wire should be flushcut, after bending to 180 degrees.



cut here,  
parallel  
to wire.



90

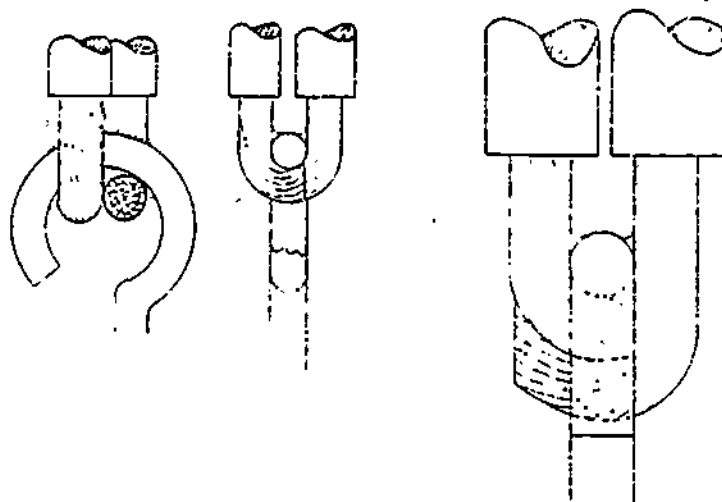


1907P7



## 2. Wire position

- a. Proper position of the wire on hook terminals requires that it be firmly in contact with the terminal; and that the wire entry be vertical to the terminal mounting surface.
- b. Wire position requirements for double or multiple wires on hook terminals are the same as for single wire connections, with the following additional requirements.
  - (1) The wires wrap around the terminal in alternating directions. This equalizes stresses and protects the glass seal at the base of the terminal from damage.
  - (2) All wires approach the terminal from the same direction (angle).
  - (3) The wires normally attach side-by-side on the terminal. If the terminal size, wire size, or number of wires dictate; a piggyback (one wire directly on top of another) mounting style is permissible but care must be taken to adjust the diameter of wire bends accordingly.
- c. Wire position requirements for tab type terminals are the same as those for hook terminals with the exception that tab terminal wire entry need not be vertical to the terminal mounting surface.

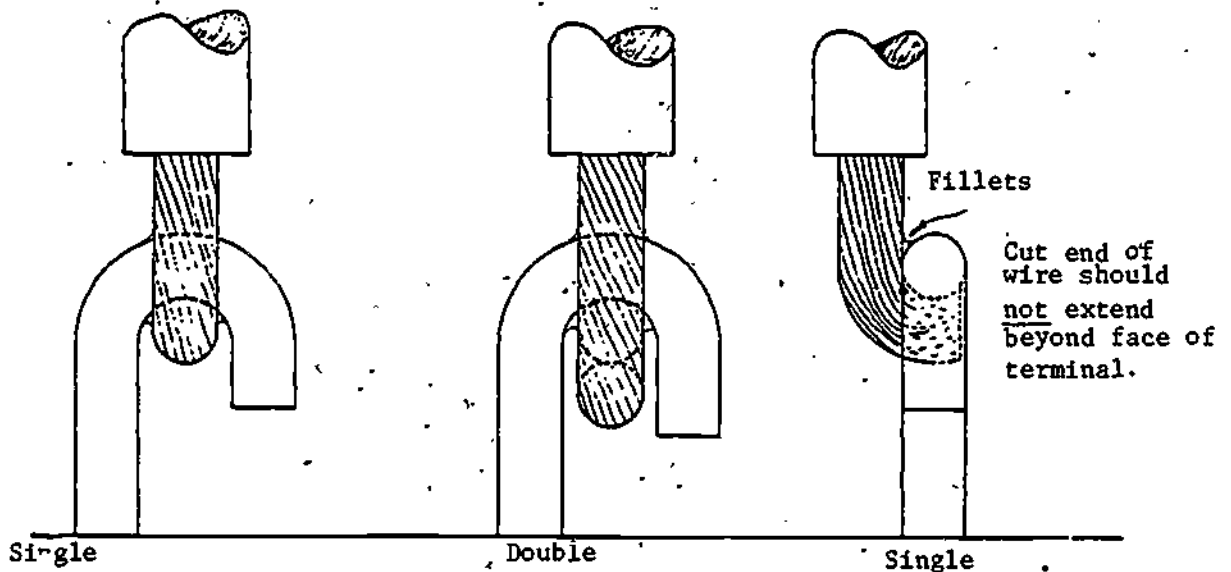


Do not fill space between wires with solder - use just enough to form good, concave fillets.

## 3. Area to be soldered.

- a. The area to be soldered consists of the portion of the terminal and wire that are in contact with each other.

- b. Smooth fillets must be formed between the wire and terminal at all areas of contact.
  - c. There must be no copper exposed on the cut end of the wire.
4. Solder quantity
- a. Solder fillets must be formed at all points of contact between the wire and terminal, and all fillets must be concave.
  - b. There must be no excessive solder flow to other areas of the terminal.
  - c. Solder quantity must be such that the contours of the wire and the individual strands are clearly visible.



E. Techniques for making high quality hook and tab solder connections.

- 1. Application of flux.
  - a. Flux contained within the solder is normally sufficient for soldering a properly cleaned and prepared connection.
  - b. External flux may be used if desired; however, its use greatly increases chances of solder wicking up under the insulation.

1490

## 2. Proper heat

- a. The proper heating source is determined by choosing a tip size and element wattage appropriate to the mass being soldered. Use the variable power control to set the tip temperature at the desired level.
- b. Proper heat flow is established by using a clean, dry iron and forming a heat bridge.

## 3. Application of solder

- a. For proper application of solder, bring a clean, dry iron into contact with the terminal and the wire.
- b. Form a heat bridge at the junction of the iron and the terminal.
- c. Form the solder fillets.
  - (1) First, tin the cut end of the wire thoroughly.
  - (2) Flow in sufficient solder to form fillets. (NOTE: A very small amount of solder is required to complete this type connection.)
  - (3) Remove the iron and the solder at the SAME time.
  - (4) Clean after soldering with an approved solvent.

## F. Inspecting completed hook and tab terminal solder connections for quality and reliability.

## 1. Standards of acceptance

- a. Check the following specifications:
  - (1) Insulation clearance.
  - (2) Wire wrap.
  - (3) Wire entry angle.
  - (4) Solder, smooth and gleaming with no pits.
  - (5) Concave solder fillets in the proper places.
  - (6) Bare wire outside of the solder connection remains flexible.
  - (7) No bare copper showing.
  - (8) Wire and strand contours visible.

- b. Multiple wire connections are inspected for all points given for single wire connections plus:

- (1) Alternating direction of wire wraps on hook terminals.
- (2) Wires entering from the same angle and parallel to each other.

- c. Reasons for rejection

- (1) Wire damage in any manner.
- (2) Solder wicking up the wire and under the insulation.
- (3) Improper solder quantity.
- (4) Poor wetting action.
- (5) Improper wire positioning and wrap.
- (6) Any copper showing.

G. Safety precautions

1. Workpiece

- a. Never perform any action on the workpiece which will cause damage or degradation.
- b. Keep scrupulously clean at all times.

2. Tool

- a. Clean and store all tools properly.
- b. Never use excessive force on any tool.
- c. Use each tool only in the manner it was designed to be used.

3. Personal

- a. Beware of burns from hot tools.
- b. When using chemicals beware of skin, eye, and internal contact, and avoid excessive inhalation of fumes.
- c. Beware of the poisonous fumes from Teflon during the stripping and soldering operations.
- d. Avoid any possibility of igniting flammable chemicals or materials.

1492

## ASSIGNMENT SHEET 3-3-1A

TITLE

Soldering to Bifurcated Terminals

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 3.3.1 PREPARE bifurcated terminals for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.
- 3.3.2 PREPARE wires for soldering by stripping, tinning and bending following the procedures and to the standards outlined in MIL-S-47543C.
- 3.3.3 CONNECT prepared wires to bifurcated terminals using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4(3A).

STUDY ASSIGNMENT

Read and study Notetaking Sheet 3-3-1N of the Student's Guide

STUDY QUESTIONS

None

## NOTETAKING SHEET 3-3-1N

TITLE

Hand Soldering Bifurcated Terminals

REFERENCES

MIL-S-45743C  
MIL-STD-454D  
NHB 5300.4 (3A)

NOTETAKING OUTLINE

## A. Types, sizes and usage of bifurcated terminals.

1. Common types - there are a variety of terminals of the bifurcated type, since nearly any terminal which has a split or a fork in it is called a bifurcated terminal.
2. Common sizes
  - a. Many sizes are used depending on the current-flow requirements of the assembly in which used.
  - b. The terminal size and wire size should correspond.
3. Uses
  - a. In most cases bifurcated terminals are used to solder many wires to a single point.
  - b. They are also used in applications exposed to high stress and current flow.

## B. Preparing bifurcated terminals for soldering.

1. Cleaning
  - a. Terminals must be cleaned prior to attaching leads or conductors.
  - b. The cleaning process used in turret terminal cleaning is also used for bifurcated terminals.
2. Tinning
  - a. Terminals should always be tinned prior to soldering.
  - b. The tinning process enhances solder flow on the connection and cleans oxides from the terminal.

C. Preparing wire for soldering to bifurcated terminals.

1. Stripping - use the same techniques and procedures as for turret terminals.
2. Tinning
  - a. Use the same techniques and procedures for turret terminals.
  - b. Good tinning technique is constant when preparing wire for any type solder connection.
3. Bending
  - a. Any method may be used for bending wire that does not damage the wire in any way.
  - b. Care must be taken not to crush, overstress, or birdcage the wire during the bending operation.

D. Bifurcated terminal solder connection specifications.

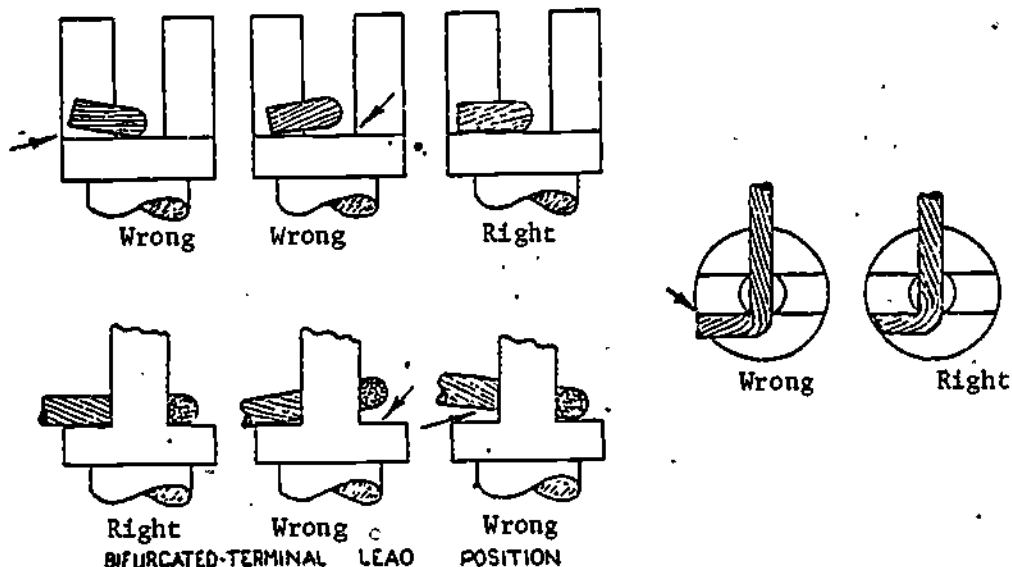
1. Wire wrap - there are three different wire wrap specifications to be considered in the bifurcated terminal connections.
  - a. The wire wrap for side entry connections shall be exactly 90 degrees, and the cut end shall be flush with the edge of the terminal base.
  - b. Bottom entry wire wrap
    - (1) The only practical method of bending the wire for a bottom entry connection is to use the terminal as a bending form, since a bent wire cannot be inserted through the bottom of the terminal.
    - (2) The bend for this type of connection must be exactly 90 degrees; however, it is not necessary to make the corner of the bend as sharp as for a side entry.
    - (3) The wire for the bottom entry connection is cut flush with the side of the terminal base.
  - c. Top entry connection
    - (1) The wire in a top entry connection is not wrapped but, if smaller than the space between the terminal ears, is pressed in with a filler wire of the correct size to provide a snug fit between the ears.

- (2) The bottom end of the filler wire must be even with the surface of the base, and the top must be cut flush with the top edge of the terminal ears.
- (3) Great care must be used when cutting the filler wire not to cause damage to the wire being brought into the terminal.

## 2. Wire position

- a. The side entry single wire connection has the following positioning specifications:

- (1) The wire shall be in contact with the surface of the terminal base as seen from front and side views.
- (2) The wire wraps around one ear of the terminal and is in contact with the inside edge and one side of that ear.
- (3) The wire is flush cut and does not overhang the edge of the terminal base.



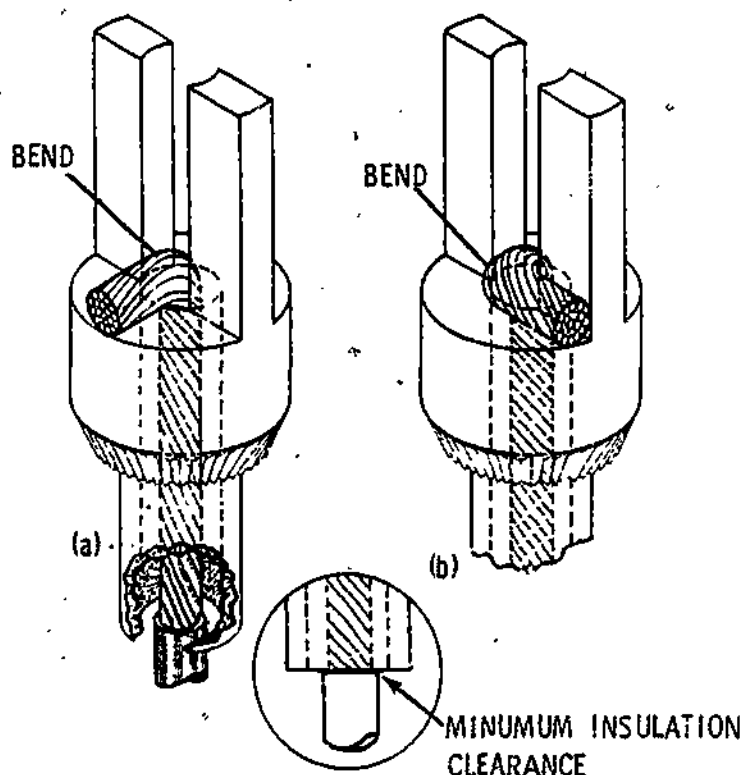
- b. The side entry multiple wire connection has the same positioning specifications as the single wire side entry with the following additional requirements:

- (1) Additional wires are wrapped in an alternating pattern to the two ears.
- (2) Wires other than the bottom wire must contact the terminal ear as specified for single connections, but will not contact the terminal base.
- (3) All wires enter the terminal from the same side and must be parallel to each other.



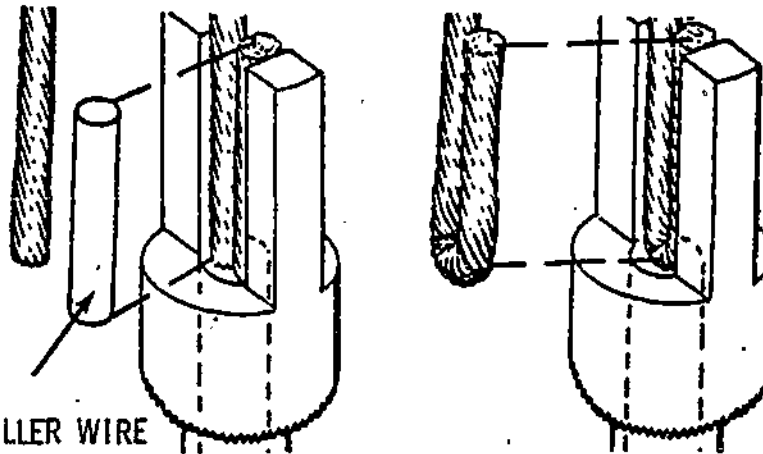
c. The bottom entry connection has the following positioning specifications.

- (1) The wire must be in contact with the surface of the terminal base from the edge of the hole out to the edge of the hole.
- (2) The wire must be cut flush with the edge of the base and must not overhang.
- (3) The wire should lie in a line drawn straight through the gap between the ears of the terminal.



d. The top entry connection has the following positioning specifications:

- (1) The cut end of the wire shall be level with the surface of the base of the terminal.
- (2) The wire shall be exactly in line with the hole through the base of the terminal.



TINNED FILLER WIRE

- e. Insulation clearance for all styles of bifurcated terminal connections shall be the same as that given for previous terminals.

### 3. Area to be soldered

- a. The entire surface of the base must be wetted.
- b. Smooth fillets must be formed between the wire and the terminal at all areas of contact.
- c. There must be no copper showing on the cut end of the filler wire.
- d. In all cases, solder must be flowed entirely over the hole through the base of the terminal, but no solder may flow through the hole beyond the bottom edge of the terminal base.

### 4. Solder quantity

- a. All solder fillets must be concave
- b. There must be no solder on any portion of the terminal other than those given as areas to be soldered.
- c. The contours of the wires and the individual strands must be visible.

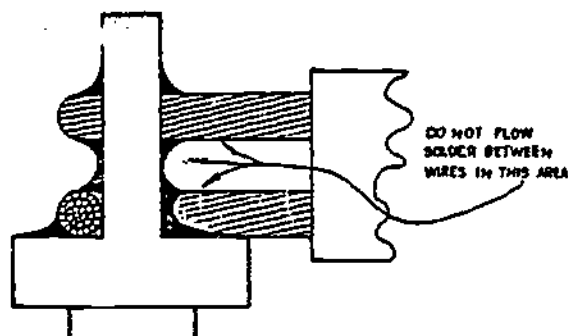
## E. Techniques for making high quality bifurcated terminal solder connections.

### 1. Application of flux

- a. Flux contained within the solder is normally sufficient for soldering a properly cleaned and prepared connection.
- b. External flux may be used if desired; however, its use greatly increases the chance of solder wicking up under the insulation.

### 2. Proper heat

- a. The proper heating source is determined by choosing a tip size and element wattage appropriate to the mass being soldered.
  - b. Proper heat flow is established by using a clean, dry iron and forming a heat bridge.
3. Application of solder
- a. For proper application of solder, bring a clean, dry iron into contact with the terminal and the wire.
  - b. For each bifurcated terminal connection style, there is a separate technique for applying solder.
  - c. The solder application technique for side entry connections with a single wire is as follows:
    - (1) Establish the heat bridge.
    - (2) Thoroughly tin the surface of the base of the terminal and the cut end of the wire. Wipe the solder around the terminal to form fillets between the wire and the terminal at all areas of contact.
    - (3) REMOVE THE IRON AND CONTINUE TO FLOW SOLDER into the hole area of the terminal (using the residual heat of the terminal to melt the solder) until the hole is completely covered with solder. This will only work if the iron is removed and must be finished before the terminal cools below the solder melting point.
  - d. The solder application technique for multiple side entry connections is as follows:
    - (1) Establish the heat bridge for a multiple side entry connection.
    - (2) Thoroughly tin the base of the terminal, remembering that there is more than one cut wire end to be tinned. Wipe the solder around the terminal to form fillets between the wires and the terminal at all areas of contact.
    - (3) Cover the hole area with solder, using the same techniques used with single wire side entry connections.



- e. The solder application technique for top entry connections is as follows:
    - (1) Establish the heat bridge.
    - (2) Thoroughly tin the base of the terminal, then wipe the solder around the terminal to form the fillets between the wire and the terminal.
    - (3) The last step is to cover the hole as in the previous methods.
  - f. The solder application technique for bottom entry connections is as follows:
    - (1) Establish the heat bridge for a bottom entry connection.
    - (2) Tin the base of the terminal, and form the fillets between the wire and the terminal at all areas of contact on the base.
    - (3) Cover the hole using the same techniques as with previous connections.
4. Cleaning after soldering.
- a. As always, a thorough cleaning must be given the connection after soldering.
  - b. Cleaning is accomplished as described previously.
- F. Inspecting completed bifurcated terminal solder connections for quality and reliability.
1. Standards of acceptance.
    - a. The following points must be examined and determined to be within specifications:
      - (1) Proper wire wraps.
      - (2) Correct wire position.
      - (3) Solder in all the required areas.

(4) Proper solder quantity.

(5) No solder defects.

2. Indications to look for:

a. Each style of bifurcated terminal has its own indications of quality.

b. The indications for single wire side entry connections are as follows:

(1) Solder, smooth and gleaming with no pits.

(2) Concave solder fillets in the proper places.

(3) No solder wicking up the wire.

(4) No copper exposed.

(5) Wire wrap and positioning correct.

(6) Wire and strand contours visible.

(7) Hole completely filled over with solder.

c. The indications for multiple wire side entry connections are:

(1) All the indications listed for a single wire joint.

(2) Additional wires must alternate direction of wrap.

(3) Smooth flows of solder forming fillets between all wires and the ear that they are wrapped to.

d. The indications for completed top entry connections are as follows:

(1) Solder; smooth and gleaming with no pits.

(2) Concave solder fillets in the proper places.

(3) No solder wicking up the wire.

(4) No exposed copper.

(5) Wire and strand contours visible.

(6) Hole completely filled over with solder.

(7) Filler wire properly inserted.

(8) Wire positioning correct.

- e. The indications for completed bottom entry connections are as follows:

- (1) The same as those listed for single wire side entry connections.
- (2) The wire must be free inside the shank of the terminal.

- f. Insulation clearance must be checked. Clearance specifications are the same whenever insulated stranded wire is used.

- (1) Minimum - not imbedded in the solder joint.
- (2) Maximum - no more than two overall diameters, including the insulation.
- (3) Preferred - One overall diameter, including the insulation.

### 3. Reasons for rejection

- a. Wire damaged in any manner.
- b. Solder wicking up the wire.
- c. Improper solder quantity.
- d. Poor wetting action.
- e. Improper wire wrap or positioning.
- f. Improper soldered area.
- g. Solder defects.

## G. Safety precautions

### I. Workpiece

- a. Never perform any action on the workpiece which will cause damage or degradation.
- b. Keep scrupulously clean at all times.

### 2. Tool

- a. Clean and store all tools properly.
- b. Never use excessive force on any tool.
- c. Use each tool only in the manner it was designed to be used.

### 3. Personal

- a. Beware of burns from hot tools.
- b. When using chemicals beware of skin, eye, and internal contact, and avoid excessive inhalation of fumes.
- c. Beware of the poisonous fumes from Teflon during the stripping and soldering operations.
- d. Avoid any possibility of igniting flammable chemicals or materials.

## ASSIGNMENT SHEET 3-4-1A

TITLE

Soldering Connector Pins

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 3.4.1. PREPARE connector pins for soldering by cleaning and tinning following procedures and to the standards outlined in MIL-S-45743C.
- 3.4.2. PREPARE wires for soldering by stripping and tinning following the procedures and to the standards outlined in MIL-S-45743C.
- 3.4.3. CONNECT prepared wires to connector pins using the proper tools and soldering techniques following the procedures and to the standards outlined in MIL-STD-454D, MIL-S-45743C and NHB 5300.4(3A).

STUDY ASSIGNMENT

Read and study Notetaking Sheet 3-4-1N of the Student's Guide.

STUDY QUESTIONS

1. The resistive tweezer type soldering tool has current flow through the \_\_\_\_\_.
2. What is the main advantage of a tungsten electrode when compared with a carbon electrode when used in resistive soldering?



TITLE

Solderable Connector Pins

REFERENCES

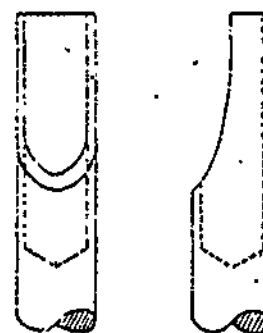
MIL-STD-454D  
MIL-S-45743C  
NH8 5300.4(3A)

NOTETAKING OUTLINE

## A. Types, sizes, and usage of solderable connector pins.

## 1. Identifying solderable pins.

- a. Although most pins can be soldered, only, certain pins are DESIGNED to be soldered.
- b. These can normally be identified by a curved cutout on one side of the pin.
- c. Additionally, pins which have a small hole drilled in the side at the bottom of the wire socket can be identified as designed for crimping only since the small hole is for visual inspection of wire bottoming prior to crimping. The hole is not for solder inspection and will allow solder to flow out the side of the pin if an attempt is made to solder the wire.



CONNECTOR CUP  
(COMMON PLUG PINS)

## 2. Common types and sizes.

- a. Connector pin size will vary from microscopically small to so large that you would strain to lift it.
- b. The common sizes you will normally encounter are those designed to accommodate wire between AWG 28 and AWG 14.

## 3. Purpose.

- a. Connector pins serve as quick, easy disconnect points for disassembly of units.
- b. Connector pins serve to pass signals and voltages through airtight bulkheads.

## B. Preparing connector pins for soldering.

## 1. Tinning - always tin the pin prior to soldering.

- a. Cleaning connector pins is difficult due to their shape; tinning is the preferred method of cleaning.

- b. In addition, connector styles which have remained unchanged for years are common, resulting in replacement connectors being used which have been stored for many years and which have the resultant oxidation on the surfaces.
- c. Also, when preparing a connector for reuse (changing wires), old solder must be removed.
- d. The most reliable cleaning method for removing unwanted solder is to wick it out.

## 2. Prefilling

- a. Prefilling (actually a form of tinning) is the placing of the correct amount of solder in the solder cup to form a finished solder joint. The use of preforms for consistent solder quantity is recommended.
- b. This eliminates the need for a third hand to apply solder while holding the wire in one hand and the heating tool in the other.

## C. Preparing wires for soldering to connector pins.

- 1. Tools used - the same tools as used for preparing wire for soldering any other terminal.
- 2. Stripping - stripping techniques are the same as for other terminal wire preparation.
- 3. Tinning - tinning techniques are the same as for other terminal wire preparation.
- 4. Bending - no wire bending is required for solder cup style connector pins.
- 5. Cutting to length.
  - a. Cutting wire to the proper length for soldering to connector pins is a relatively easy job.
  - b. Merely insert the wire into the connector cup to measure the length of wire needed for that size of pin.
  - c. Be sure that the pin used as a depth gauge is empty of solder.
  - d. After the first wire is cut to the proper length, it can be used as a gauge for cutting other wires of the same size which are to be used in the same size of cup.

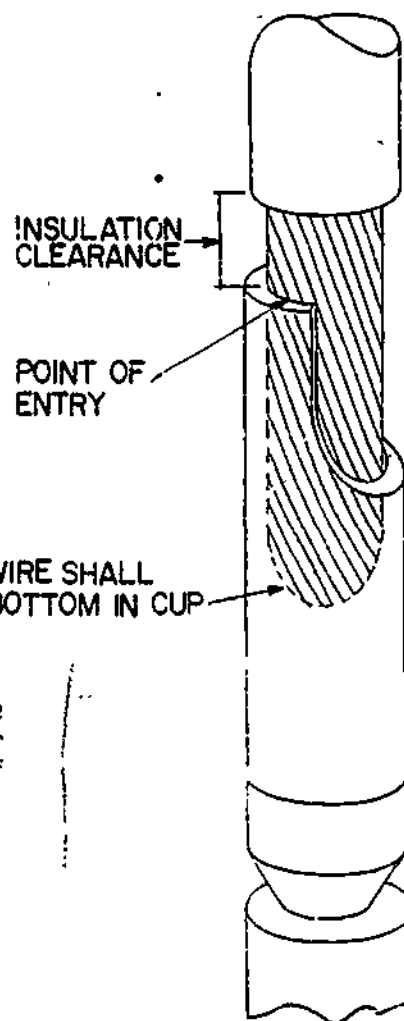
7894P8

## 6. Insulating tubing

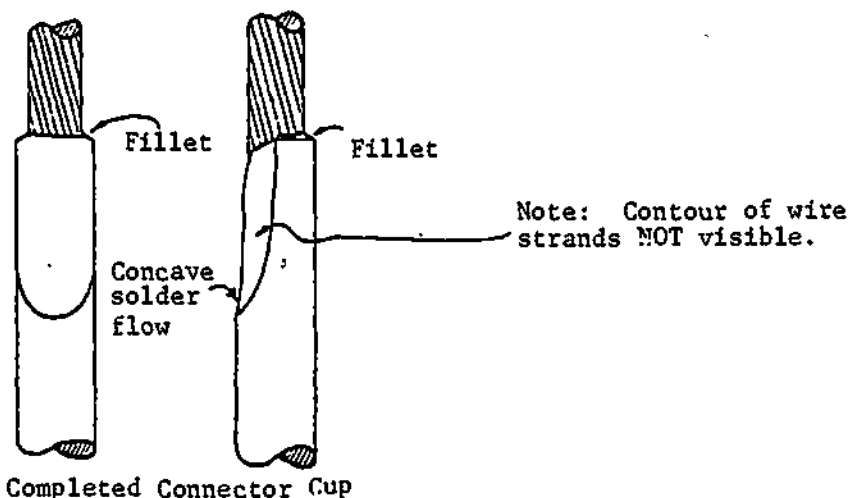
- a. It is recommended that insulating tubing be used on all connector pins due to their close proximity and the danger of electrical short circuits.
- b. Insulating tubing may be either the fixed size type or the heat-shrinkable type.
- c. Heat-shrinking tubing is recommended as it provides good insulation with less bulk and is not subject to slipping up off the connection.
- d. ALWAYS insert insulation tubing over the wire prior to soldering.
- e. Tubing may be shrunk by using the solder extractor unit in the pressure mode for a heat source.
- f. Always exercise extreme caution when applying heat to shrinkable tubing (too much heat is worse than not enough).

## D. Connector pin solder connection specifications.

1. Wire wrap - as with bending, there is no wrapping to be done on connector pins.
2. Wire position - the wire shall be aligned exactly with the axis of the pin cup.
3. Wire depth - the wire MUST BE BOTTOMED IN THE SOLDER CUP to prevent flux or air being entrapped in the bottom of the solder cup.
4. Areas to be soldered.
  - a. The solder cup should be filled with a quantity of solder that will NOT allow the wire strands to be visible after soldering, but does not bulge beyond the confines of the cup or spill down over the sides of the pin.
  - b. The edges of the cutaway portion of the cup shall be visible beneath the solder with no portion of the internal face of the solder cup showing.



- c. There shall be a circular, concave fillet around the wire where it enters the solder cup.
5. Solder quantity - the solder quantity shall be such that there shall be no solder spillage onto the outer walls of the pin, and the edges of the solder flow at all points shall meet the pin or wire in a concave fillet.



#### E. Tools used to make connector pin solder connections.

1. Handtools
  - a. Vise
  - b. Antiwicking devices
2. Power tools
  - a. Soldering iron
  - b. Variac
  - c. Resistance soldering tweezers
  - d. Resistance soldering probe

#### F. Techniques for making high quality connector pin solder connections

1. Application of flux - except for the flux contained in the solder the application of flux is undesirable except in cases of extreme oxidation since excessive flux may become trapped in the bottom of the solder cup or cause solder spilling onto the outside of the pin.
2. Proper heat

- a. In soldering connector pins there are three primary methods of applying heat, all of which are reliable.

- (1) Soldering iron
- (2) Resistance probe
- (3) Resistance tweezers

NOTE: There are two types of tips for resistance soldering, Carbon and Tungsten, each having its advantages: (1) Carbon is easier to keep clean, and provides greater heat, but is extremely fragile (2). Tungsten oxides and requires greater attention to keep clean, but is much more durable.

- b. Conductive heating with the soldering iron is an acceptable method but it has the following disadvantages:

- (1) The tip must be extremely clean and dry to prevent leaving solder tins on the outside of the pin.
- (2) The entire heating element of the iron must be hot for it to do its work, which may burn surrounding wires and insulation.

- c. Resistance heating with the probe (which heats by high current flow through the resistance of the pin itself) has the following disadvantages:

- (1) It requires a second conductive lead which must be attached to some other part of the pin.
- (2) Holding the single probe point against the rounded surface of the pin causes slippage which can result in severe arcing and burning of the pin.

- d. Resistance heating with the resistance tweezers heats by the same method as the probe and has only the one disadvantage of arcing if misused.

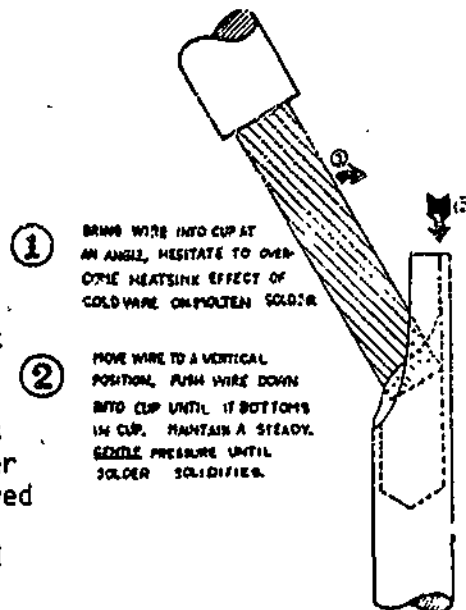
- e. Resistance soldering is extremely fast and efficient as a heating source and should be controlled by the following means:

- (1) The current flow must be adjusted to the proper level for the thermal mass of the pin and wire.
- (2) Great care must be used in adjusting the current level since most resistive heating sources are capable of pin DESTRUCTION by overheating if the current level is set too high.

- (3) If using a stepped current source, fine control of generated heat is accomplished by utilizing a pumping action of the footswitch to apply power intermittently.

### 3. Application of solder.

- a. In connector pin soldering, the wire is applied to the solder rather than applying the solder to the wire.
- b. To properly apply the wire to the solder, use the following steps:
  - (1) The first step should be to place an antiwicking tool on the wire. The wire insulation should always be firmly bottomed in the larger section of the hole drilled through the tweezer tool head, and the jaws thoroughly cleaned of any flux or other dirt.
  - (2) If using the resistance heating method, thoroughly clean the tool tip with crocus cloth prior to placing the tips on the terminal as oxide buildup may cause arcing.
  - (3) You must always place the tool tip on the pin prior to applying power to prevent arcing and burning of the pin.
  - (4) Apply power (or the soldering iron) and observe the pin for solder melt.
  - (5) Upon solder melt, immediately insert the tip of the wire partially into the solder cup at about a 70 degree angle and hesitate for a second to allow heat sinking action of the wire to be overcome.
  - (6) After the solder remelts, VERY QUICKLY move the wire to a full vertical position and bottom it in the solder cup.
  - (7) Maintain a slight downward pressure on the wire until the power (soldering iron) has been removed and the solder has solidified. This downward pressure will aid in preventing the formation of stress lines in the solder.



### 4. Cleaning after soldering.

1510

- a. As ALWAYS, the soldered connection must be properly cleaned after completion of the soldering operation.
  - b. The most effective cleaning method for connector pins is the use of a bristle brush and solvent.
- G. Inspecting completed connector pin solder connections for quality.
- 1. Standards of acceptance.
    - a. Correct insulation clearance.
    - b. Proper solder fillets.
    - c. Proper solder quantity.
    - d. SMOOTH gleaming solder finish.
  - 2. Indications to look for.
    - a. Preferred solder connections.
      - (1) Concave solder fillets.
      - (2) Bright, gleaming solder finish.
      - (3) Ideal amount of solder.
      - (4) No solder spillage.
      - (5) Correct insulation clearance.
    - b. No solder defects, especially stress lines, which are common in solder cup connections.
  - 3. Reasons for rejection.
    - a. Improper insulation clearance.
    - b. Solder spilled over the sides of the terminal.
    - c. Arc spots on the sides of the terminal caused by improper use of the resistance soldering tools.
    - d. Birdcaged wires.
    - e. Stress lines.
    - f. Nicked or damaged wires.
    - g. Solder defects.

#### H. Safety precautions.

##### 1. Workpiece

- a. Never perform any action on the workpiece which will cause damage or degradation.
- b. Keep scrupulously clean at all times.

##### 2. Tool

- a. Clean and store all tools properly.
- b. Never use excessive force on any tool.
- c. Use each tool only in the manner it was designed to be used.

##### 3. Personal.

- a. Beware of burns from hot tools.
- b. When using chemicals beware of skin, eye and internal contact, and avoid excessive inhalation of fumes.
- c. Beware of the poisonous fumes from Teflon during the stripping and soldering operations.
- d. Even though the resistance tools are operated at a very low voltage, there is always a chance of shock if the hands are wet. Use common electrical safety precautions to prevent injury.

1512



## ASSIGNMENT SHEET 4-1-1A

TITLE

Introduction to Micro-electronic Circuit Boards

OBJECTIVE

When you complete this lesson topic, you will be able to:

- 4.1.1 IDENTIFY the characteristics and handling of micro-electronic circuit boards. Identification will be in complete agreement with the characteristics outlined in MIL-STD-454D.

STUDY ASSIGNMENT

Read and study Notetaking Sheet 4-1-1N of the Student's Guide.

STUDY QUESTIONS

None

## NOTETAKING SHEET 4-1-1N

TITLE

Introduction to Micro-Electronic Circuit Soldering

REFERENCES

PACE Rework and Repair Technology Series  
MIL-STO, 454D

NOTETAKING OUTLINE

- A. Definition and scope of micro-miniature electronic repair.
1. Micro-miniature electronics repair, as it pertains to this lesson, is any electronic repair which requires a performance skill level greater than that possessed by the "average" repair technicians.
  2. Abilities and skills to be achieved during the course.
    - a. Proper identification and use of all components of the 2M micro-miniature electronic repair stations.
    - b. Correct analyzation of workpiece construction and evaluation of the damage to be repaired.
    - c. Identification of high quality micro-miniature solder connection characteristics.
    - d. Proper utilization of tools and repair techniques to remove conformal coatings, perform desoldering operations and remove components from the workpiece.
    - e. Proper utilization of tools and repair techniques to install micro-miniature electronics components on single and double sided printed circuit boards.
    - f. Correct preparation, application and curing of conformal coatings.
- B. Characteristics of micro-miniature solder connections on single and double sided printed circuit boards.
1. Soldered area
  2. Solder quantity
    - a. Preferred - fillets up to the half way point.
    - b. Acceptable - fillets no more than the three-fourths point.
    - c. Lead contours must be visible through the solder.

### 3. Solder finish

- a. The solder must have a bright gleaming appearance.
- b. There must be no pits, holes or other blemishes.

### 4. Wetting

- a. Solder must flow to the edges of the pad being soldered.
- b. Solder must blend smoothly into the soldered surface with no ridged appearance at the edge of the flow.

### 5. Solder defects - All connections must be free of all types of defects as described in the lesson on High Reliability Soldering.

## C. Characteristics and handling of micro-miniature circuitry.

### 1. Circuitry characteristics

- a. There are many characteristics of electronic circuitry used today which require that the technicians performing the repair possess exceptional skill.
- b. The first characteristic to be considered is the minute size of the components and their associated circuitry.
  - (1) Size is one of the most common factors requiring special skills of the repair technician since a microscope must often be used to perform or inspect the work.
  - (2) Size alone, however, is far from being the only characteristic requiring special repair skills.
- c. Another common characteristic is conformal coatings which are extremely difficult to remove. This situation often requires skills well above the average level to remove the coating without causing damage to the components and the associated circuitry on the workpiece.
- d. Components which are highly susceptible to various types of damage are a characteristic of micro-miniature electronics. Components in this category require a very high skill level in handling, removal and replacement.
- e. Circuit board laminates often require above average skills of the repair technicians due to size, damage susceptibility or complexity.
- f. Another circuit characteristic which requires micro-miniature electronics level repair skills, although the circuitry and components are not "micro-miniature" as such, is high density packaging of standard discrete components.

- g. A final characteristic and the one generally requiring the most skill to perform the repair, is that of extensive damage to the workpiece.
    - (1). When extensive workpiece damage exists, the repair is often more a manufacturing process than a repair process. For this reason a great deal of skill is required of the repair technician when repairing extensive damage.
    - (2) This type of repair action also requires, in most cases, a number of special materials which are not generally available to the average repair technician.
  - h. Beside the requirements for special skills, many of the characteristics of micro-miniature electronic circuits also necessitate the use of special tools. The delicacy and expense of these tools preclude their distribution to any but a select few highly trained and skilled repair technicians.
2. Proper handling techniques
- a. To avoid workpiece damage, constant attention and care must be given to handling procedures both before and after the repair process, as well as during the repair process.
  - b. During the repair process particular attention must be given to the use of proper repair techniques to avoid causing damage to components or circuits.
  - c. During all stages of handling remember that someone's life generally depends upon the proper functioning of the workpiece you are repairing.

## INFORMATION SHEET 4-1-11

TITLE

Publications for use in Miniature/Micro-miniature Repair

INTRODUCTION

Some of the most valuable aids in any technical job are the publications associated with it. Many of the publications the repair technicians will need to know to perform miniature/micro-miniature repairs, which are not commonly used by technicians, who will generally be unfamiliar as to their use. The information section below is a result of knowledge gleaned from experienced repair technicians, and it explains some of the types and uses of publications associated with miniature/micro-miniature repair.

INFORMATION

There are many sources for obtaining information needed to complete a repair. These may be Naval or other types of publications. The Navy has three general types of publications that are commonly used in miniature/micro-miniature repair, which are: (1) Supply manuals, (2) Instruction manuals, and (3) Military Specifications. The specific publications and their uses are listed below:

## Supply Manuals -

1. Illustrated Parts Breakdown - used to provide data needed to procure parts needed for the workpiece repair. IPB's give a detailed breakdown of all parts and hardware of a specific system, unit, or submodule.
2. Federal Stock Class Manual - used to provide data on procuring general supplies, such as tools, eyelets, wire etc. The federal stock class is a four number code (the first four digits of a national stock number) which identifies the type of item the stock number pertains to, i.e., 5905 is the federal stock class for resistors. There is an FSCM for each federal stock class, which lists all items of that class which are stocked within the supply system. The following list covers some of the most commonly used FSCM's.
  - a. 5325 - Printed circuit eyelets
  - b. 5120 - Handtools
  - c. 5940 - Terminals and standoffs
  - d. 6145 - Electrical wire
  - e. 6520 - Dental supplies

## Instruction Manuals -

1. Overhaul instruction manuals - contains complete maintenance procedures including parts procurement data on individual

1385P8

119

1517

workpieces. These are usually written on those items considered too delicate or complex for field level maintenance. The overhaul manual will list any special handling or disassembly procedures.

2. Generalized technique manuals - these manuals cover such categories as wiring techniques, repair techniques, and inspection techniques that are applicable to all types of equipment, and do not pertain to any one specific equipment, except when that type of work is being done on the individual piece.

#### Military Specifications and Standards -

As their name suggests, these publications are regulatory in nature and require mandatory compliance. These may either be general in nature or for a specific equipment. They provide specific instructions, acceptance standards, and technical limitations or applications for materials, processes, and techniques.

In addition to Naval publications, there are other sources for the information that a repair technician may need to complete the repair. Some of these are listed below, along with their uses:

1. Manufacturers specification or process documents - these contain the same type of information as Military specifications, and provide the specifications that the manufacturer used to produce the equipment. They will generally list any of the Military Specifications that apply.
2. Commercial reference texts - these are publications which provide data on general repair techniques or processes, such as soldering.
3. Commercial suppliers catalogs - used to select or procure needed repair tools or materials which are not available from the Navy supply system.
4. Government repair references - these publications are available from other government agencies, such as NASA, and provide the same type of information on repair techniques as the generalized technique manuals of the Navy.
5. Specifications or Standards - these are publications of other government agencies which serve the same purpose as Military Specifications and Standards. These are usually available from such agencies as NASA and the Marshall Space Flight Center.

#### SUMMARY

Many publications are needed to repair miniature/micro-miniature electronics, and the repair technician must be familiar with most of the ones listed in this sheet to do his job correctly.

## ASSIGNMENT SHEET 4-2-1A

TITLE

Microminiature Repair Task Identification and Procedural Analysis

OBJECTIVE

When you complete this lesson topic, you will be able to:

- 4.2.1 IDENTIFY the repair task of various types of micro-electronic circuit boards by visual inspection and a procedural analysis of selected micro-electronic circuits. Identification will be in agreement with the connections listed in Volume 6 of the PACE Rework and Repair Technology Series.

STUDY ASSIGNMENT

Read and study Notetaking Sheet 4-2-1N of the Student's Guide.

STUDY QUESTIONS

None

## NOTETAKING SHEET 4-2-1N

TITLE

Micro-Miniature Repair Task Identification

REFERENCES

MIL-STD-454D

PACE Rework and Repair Technology Series

NOTETAKING OUTLINE

A. Circuit board construction - Only those construction details which you have not learned in previous lessons will be covered in this lesson.

1. Extremely high density circuits.

- a. One category of module you will be required to work on, in micro-miniature electronics repair, is the type which uses standard circuitry and discrete components, but is constructed using extremely high density component packaging.
- b. The use of standard packaging, unless other complications of construction such as thick coatings or welded leads exist, is not a microminiature task.
- c. Both standard and high density packaging may be a micro-miniature repair task if the failure occurs in a high density area.
- d. The extremely high density packaging and epoxy potting used on some modules makes it necessary to use micro-miniature repair techniques on the module, even though it may only have standard size discrete components.

2. Hybrid circuits

- a. A hybrid circuit is one which contains both discrete components and micro-miniature components.
- b. Hybrid circuits are a second category which require the use of micro-miniature repair techniques.
- c. Some of the types of hybrids are:
  - (1) Discrete components and IC's.
  - (2) Discrete components and ceramic printed circuits (CPC's)



- (a) The CPC's may be of the thick or thin film type.
- (b) Thin film is a term used to denote the method by which film circuitry (conductive, resistive, or dielectric ink) is applied to a substrate.
- (c) The substrate is usually made of Alumina ceramic material which has a very high thermal conductivity, low dielectric loss even at high frequencies, and can withstand very high temperatures. The substrates are usually from 0.010" to 0.035" thick.
- (d) Thin film circuitry is deposited in a vacuum by vacuum deposition (vaporizing material in a vacuum at 200 degrees to 400 degrees C.) or cathode sputtering (using an electric potential to discharge material into a vacuum).
- (e) The conductor thickness is 10,000 to 30,000 Angstroms (25,000 A = 0.0001") and the width is 0.005 to 0.020".
- (f) When finished, thin film circuits are coated with powered glass (fired at low temperature) or with polyurethane.
- (g) Thick film circuits have the material deposited on the substrate by silk screening.
- (h) The conductor thickness on thick film types is 0.005" to 0.006" and the width is 0.020" average.

### 3. Multilayer printed circuit boards.

- a. Multilayer printed circuits (MLPCB's) are used widely in some systems to reduce the size and space taken up by interconnecting wiring.
- b. Multilayer boards are made up of a series of very thin conducting and insulating layers which are laminated together to form a single circuit board.
- c. The current complexity of these boards is such that computers are generally required to layout and test their physical design.
- d. The individual board layers are a double sided circuit lamination of 0.002" copper on a 0.003" thick insulation layer.
- e. These thin layers are pre-impregnated with epoxy and then laminated together with heat and pressure to form the finished board.

NOTE: Multilayer printed circuit boards are to be repaired ONLY by FULL micro-miniature repair technicians who have graduated from the NAVAIR Micro-Miniature Repair Course.

#### 4. Flexible printed circuits

- a. Flexible printed circuits are a fairly recent development in circuit technology.
- b. Flexible circuits are highly reliable and seldom need repair. When repair is needed, the complexity and materials required demand that micro-miniature repair techniques be used.
- c. Flexible printed circuits are constructed of a copper conducting layer laminated between two layers of polyimide plastic film. Multilayer flexible circuits are also made using the same techniques.

NOTE: Flexible printed circuits are to be repaired ONLY by FULL micro-miniature repair technicians who have graduated from the NAVAIR Micro-Miniature Repair Course.

#### B. Conformal coating compounds

##### 1. Coatings on micro-circuits.

- a. The conformal coatings you will deal with in micro-miniature repair are the same types that you learned to identify in previous lessons.
- b. The application and removal of these coatings when repairing micro-miniature circuits becomes much more critical and demand vastly increased skill levels on the part of the repair technician.
- c. Many times a coating may be technically defined as thin if measured, but it must be treated as a thick coating due to the relationship between the coating thickness and the component size.
  - (1) A thin coating on a micro-miniature circuit, which is extremely difficult to remove from around the circuit component leads, must also be removed nearly 100% to enable desoldering tools to properly contact the solder pad area.
  - (2) Any coating which must be removed from micro-miniature circuits should have removal performed using only micro-miniature repair techniques due to the danger of damaging the components or workpiece.

## 2. Extremely thick coatings

- a. Extremely thick coatings are not often encountered on circuitry using micro-miniature components unless they are completely potted or encapsulated with the coating.
- b. You will, however, occasionally encounter micro-miniature modules with extremely thick coatings such as polyurethane and epoxy.

## 3. Opaque coatings

- a. Opaque coatings are very common in micro-miniature electronic circuitry.
- b. Opaque coatings are generally used to completely pot or encapsulate either individual components or the entire module.
- c. The majority of conformal coatings are not opaque; thus, most opaque coatings are deliberately made opaque by manufacturers for one of the following reasons:
  - (1) Opaque coatings are used on highly classified circuitry as a security measure.
  - (2) Opaque coatings are also used by manufacturers to maintain security of unique design and manufacturing processes.
  - (3) One of the most common uses for opaque coatings is their application by manufacturers to serve as a detriment to repair. This is done so that the circuits will be replaced rather than repaired.

## 4. Special coating additives

- a. In addition to additives which make coatings opaque, there are additives used which increase the adhesion strength of the coating and make penetration more difficult.
- b. One typical additive is aluminum oxide particles. These particles are mixed with the coating while it is in a liquid state. When the mixture is cured, it forms a compound so hard and abrasive that it will rapidly dull even diamond-tip instruments. This compound is most commonly used by manufacturers to protect trade secrets or to prevent repair.

- c. Another common additive is powdered silica (sand). This additive forms a coating compound even harder than aluminum oxide. Diamond-tip cutting instruments are, completely useless for this compound. This is most commonly used for security purposes on highly classified equipment.

### C. Micro-miniature component characteristics

#### 1. Heat sensitivity

- a. Nearly all micro-miniature electronic components are highly susceptible to damage by heat.
- b. If the internal parts of a micro-miniature component are allowed to reach soldering temperatures for even a short period of time, damage will result.

#### 2. Electrical sensitivity

- a. Except for a very few high power or high voltage devices, all micro-miniature electronic components may be damaged by extremely small electrical potentials.
- b. In addition to powered circuits, these potentials may be developed from such things as stray voltages on power soldering tools or static electricity from your fingers.
- c. To avoid damage, constant care must be taken to ensure that no stray voltage potential of any sort is allowed to contact component leads.
- d. Particular care must be taken with normal circuit operating potentials since they will almost invariably cause damage if applied to the wrong leads.

#### 3. Mechanical sensitivity

- a. All micro-miniature electronic components are sensitive to, and easily damaged by, mechanical stresses.
- b. The delicate crystalline structure of the IC chip and the glass hermetic seal around leads are both easily damaged by stresses such as dropping the component or cutting the leads with dull cutters.
- c. Excessive force or stress, applied when positioning the component or bending leads, is one of the most common causes of damage.

#### 4. Physical size

- a. There are literally thousands of different size/shape combinations used in making micro-miniature electronic components.
- b. During the previous lessons, you have been shown the most common shapes of these components.
- c. Their size varies to such a great extent that it is not practical to attempt to show all the variations. Size may range from an inch or more to such microscopic dimensions that it is nearly impossible to distinguish the component with the naked eye.

#### D. Solder joint construction

##### 1. Through board joints.

- a. During previous lessons you have been shown most of the through board solder connection styles, but there are some styles used with micro-miniature electronic components which you are not familiar with.
  - (1) The entire pad diameter of some solder joints may be only approximately 0.025". It is extremely difficult to avoid damage when soldering and desoldering through board joints on circuitry of this size.
  - (2) Due to the small size, and inaccurate drilling, some pads may be drilled off center during the manufacturing process, resulting in a knife edge thinness of some pad edges. Extreme care must be used to avoid lifting or breaking these pads during repair operations.

##### 2. Surface joints

- a. Surface type joints are commonly called lap joints.
- b. In this type of joint the component lead is placed or lapped on top of the solder pad area and soldered into place.
- c. All connection and bonding in the surface or lap joint is formed by the solder itself. For this reason the quality and strength of the solder connection in this type of joint is exceptionally critical.
- d. Surface joints are a very common mounting style for IC's and other micro-miniature electronic components.

### 3. Circuit board solder cups

- a. Circuit board solder cups are a hollow standoff similar to a connector pin.
- b. The purpose of the solder cup is to act as a connection point for several component leads when vertical component mounting is used.
- c. Solder cups are not micro-miniature, but they are normally found on a module whose packaging density requires micro-miniature tools or techniques for repair.

### 4. Welded leads

- a. Welded leads are a fairly common occurrence as a mounting style for micro-miniature electronic components.
- b. Welds will either be parallel gap or point contact style.
  - (1) The most common weld currently in use is the parallel gap style. It is generally used when only one of the conductors to be joined is free to move. This style is readily identifiable as it leaves a thin black line across the welded lead. A parallel gap weld is formed by bringing two parallel tips into contact with one of the leads to be joined and passing a high current pulse between the tips.
  - (2) Point contact welding is an older style and is generally used where both conductors to be joined are free to move. The point contact weld is formed by bringing two tips together so that the conductors to be joined are pressed between the tips. Only very careful inspection will show that this type of joint is welded rather than soldered.

## E. Evaluating repair tasks and procedural steps

### 1. Workpiece analysis

- a. You have been taught in previous lessons that before taking any action towards the repair of a workpiece, both the workpiece and the job to be done must be thoroughly analyzed and a complete plan of action decided upon.
- b. At this point in the course, you have been taught the information needed to enable you to make a complete analysis of micro-miniature electronic workpieces.
- c. When making an analysis of each workpiece, you are performing the most important part of insuring that no additional damage or degradation is incurred on the workpiece as a result of your repair actions.

## 2. Damage evaluation

- a. The next step of your preparation for repair is to locate all damage or degradation on the workpiece, and determine their extent.
- b. The nature of all damage and the area affected must be determined before you can effectively outline the repairs to be performed.

## 3. Task determination

- a. When the workpiece has been completely analyzed and all damage evaluated, you will have the information needed to decide what repairs must actually be performed on the workpiece.
- b. In determining the repair task (or tasks) remember that all steps taken in disassembly, repair and reassembly are a part of the overall repair task.

## 4. Procedural outline - The final step in preparation for repair is to combine the information gained from analyzing the workpiece, the damage and the repair task into a single comprehensive step-by-step repair procedure.

## ASSIGNMENT SHEET 4-3-1A

TITLE

Micro-electronic Circuit Conformal Coating Removal and Desoldering Techniques

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 4.3.1 EVALUATE the repair task to be performed and DETERMINE the proper conformal coating removal method to be used on micro-electronic printed circuit boards. Evaluation and determination will be based on information contained in Volume 6 of the PACE Series.
- 4.3.2 REMOVE various conformal coatings from micro-electronic printed circuit boards using the chemical, heat and abrasive methods and the proper tools as outlined in Volume 6 of the PACE Rework and Repair Technology Series.
- 4.3.3 DETERMINE the proper desoldering and component removal method to be used on selected micro-electronic printed circuits utilizing information contained in Volume 6 of the PACE Series.
- 4.3.4 DESOLDER various types of micro-electronic printed circuit solder connections using the wicking and motorized vacuum extraction methods of desoldering and the proper tools as outlined in Volume 6 of the PACE Series.

STUDY ASSIGNMENT

Read and study Notetaking Sheets 4-3-1N of the Student's Guide.

STUDY QUESTIONS

None

1528



## NOTETAKING SHEET 4-3-1N

TITLE

Micro-Electronic Circuit Conformal Coating Removal and Desoldering Techniques

REFERENCES

PACE Rework and Repair Technology Series, Vol. 6  
MIL-STD-454D

NOTETAKING OUTLINE

A. Conformal coating removal techniques

1. Heat removal

- a. You have been taught in previous training that the careful application of controlled heat can be used to remove many conformal coatings. This is also true in micro-miniature electronic repair.
- b. The heat removal methods and tools which you learned to use on standard miniature modules is not practical for removing coatings from micro-miniature electronic modules due to the size and spacing of the components.
- c. In this lesson you will learn to apply controlled heat using the more specialized tools and techniques which are applicable to micro-miniature electronic circuitry.

2. Abrasion removal

- a. Mechanical abrasion is another useful method of removing coatings, but once again, the tools and techniques you have already learned to use are not suitable for micro-miniature electronic circuits.
- b. You will learn to use the improved tools and techniques to remove coatings from micro-miniature electronic circuits by mechanical abrasion.

3. Chemical removal

- a. The use of solvents to remove coatings is very limited, since those solvents which are strong enough to dissolve coatings also tend to attack some of the components.
- b. Always use only the solvents and procedures for coating removal which are recommended in the coating manufacturer's specifications, keeping in mind that some of the components may still be damaged by that solvent.

## B. Use and capabilities of coating removal tools

### 1. Hot air jet

- a. The hot air jet technique is one of the most versatile coating removal methods.
- b. The hot air jet technique uses the solder extractor in conjunction with low air pressure.
- c. The equipment is set up as follows:
  - (1) Adjust the voltage control for the extractor to obtain the desired temperature.
  - (2) Connect the extractor air line to the pressure output and turn the pressure control to get minimum air flow.

**CAUTION:** At maximum voltage the air temperature is approximately 1000 degrees F. and can cause great damage to the workpiece if improperly used.
- d. To remove coatings with the hot air jet, proceed as follows:
  - (1) Blow hot air from the extractor tip onto the area to be removed. Keep the extractor tip approximately 1/2 inch away from the surface.
  - (2) Use extreme care not to cause damage to the workpiece.
  - (3) Using an orangewood stick or a similar tool, push the coating away as it softens or overcures from the hot air jet action.
- e. Using the hot air jet and a fine pointed tool, coatings can be removed from even the most minute areas.

### 2. Thermal parting

- a. Another very versatile heat removal tool is the thermal parting unit.
- b. To prepare for thermal parting, proceed as follows:
  - (1) Connect the thermal parting tool to the low voltage A.C. output.

1530

- (2) Depress the footswitch.
- (3) Adjust the output control until the parting tool tip is at a temperature just below the melting point of solder.

**CAUTION:** ALWAYS begin the adjustment procedure with the output control set at zero to avoid damaging the parting tool.

- (4) The temperature may now be adjusted slightly up or down to obtain the best results with the particular coating being removed.

c. To remove coatings with the thermal parting tool, proceed as follows:

- (1) Remove the coating from around the component body by overcuring and pushing the coating aside with the hot parting tip. The tip should not be hot enough to cause scorching or discoloration of the coating.
- (2) Carefully remove the coating from around the leads, being very careful not to touch to board surface. The coating need only be removed down to the widest point of the component body, and from the pad area on a double sided board. The coating must also be removed from the pad area on the termination side of the board, on both single and double sided boards.
- (3) If you are removing a failed component, the leads may be cut at this time. This destructive removal method is preferred when removing a KNOWN defective part, as it is the method which normally provides the lowest risk of workpiece damage.
- (4) When the component leads have been cut, the component body should be heated, causing the remaining coating to soften and permit easy component removal.
  - (a) One method of heating the body is to use the thermal parting tool.
  - (b) A temperature controlled soldering iron or the hot air jet are reliable methods of heating the component body.
- (5) Once the component body has been thoroughly heated to weaken the coating bond, it may be removed by gripping it with a pair of pliers and applying a gentle twisting or rocking force. Never use a pulling or lifting force as it could result in board or conductor damage.

- (6) When the defective component has been removed, the leads must then be desoldered and removed from the board.
- (7) After the part is removed from the board, the surface area of the board must be smoothed and cleaned to accept the replacement part. This smoothing may be done with the thermal parting tool, or by abrasive grinding methods.
- (8) If non-destructive component removal is necessary, the same basic procedure is followed using two additional steps.
  - (a) When removing the coating from the component leads, remove the coating down to the pad area, exposing the solder connection.
  - (b) Completely desolder the component leads prior to heating the component body for removal.

### 3. Abrasive removal

- a. The motor tool is another reliable method of removing conformal coatings.
- b. A wide variety of bits are available for use with the motor tool. These bits allow the removal of various coatings from many different surfaces.
  - (1) The ball mill type bit is generally used only to take off the majority of a thick coating.
    - (a) Small ball mills may also be used to remove coating materials from confined areas around component bodies.
    - (b) When removing a coating with a ball mill, use EXTREME CAUTION and NEVER attempt to remove a coating completely with this method.
  - (2) Abrasive grinding bits may be used to remove coatings from small conductors or large flat surfaces, with less chance of damage than a ball mill.
    - (a) The rotary bristle brush is generally the most reliable method of removing coatings from confined areas since it is small and will form itself into the shape of the area it is in contact with.

- (b) The rotary bristle brush is an excellent tool for removing thin coatings completely down to the board surface without causing damage. Do not be deceived by the apparent softness of the brush, as it is highly abrasive and will cause serious damage to the laminate and conductors if it is applied with undue pressure.

### C. Desoldering micro-miniature solder connections

1. The majority of all damage caused during the repair cycle of a module has always happened in the disassembly (component removal) phase of the work, and the largest percentage of this damage has occurred during a single operation, DESOLDERING OF COMPONENTS. The following are reliable methods of desoldering: continuous vacuum; pressure; and the motor tool in certain cases.
2. Vacuum desoldering
  - a. Of all the various methods of solder extraction currently in use, the most versatile and reliable is the continuous vacuum method. Tools using this method have been found to greatly outperform all other methods for general use when operated by trained personnel.
  - b. Much desoldering which is very difficult or nearly impossible to perform RELIABLY with other methods is a routine matter using the continuous vacuum extraction tools.
3. Pressure desoldering
  - a. As you have learned, hot air at approximately 1000 degrees is available when using the extractor in the hot air jet mode.
    - (1) The hot air jet can be used to blow solder out of dead end holes when vacuum will not do the job.
    - (2) The hot air jet also allows you to melt solder and remove lap-soldered leads from a distance if they are inaccessible. It also allows the lead to be desoldered without touching the hot tip to the joint when the pad or board laminate are extremely sensitive to heat and pressure.
4. Removal of welded leads
  - a. It is often necessary in micro-electronics to repair modules with welded component connections, even though we do not have welding or, dewelding capabilities.
  - b. Using the tools and techniques taught in this course you will be able to remove welded leads and install replacement components by soldering.

#### D. Use and capabilities of desoldering tools.

1. Solder extractor - You have already been trained in the proper use of the solder extractor as a continuous vacuum device, so it is only necessary at this point to briefly review reliable extraction procedures:
  - a. Always use a stirring motion of the lead if possible, so that no sweat joints remain after desoldering (this is particularly important with multilead components).
  - b. Except for very rare instances where you have no alternative, NEVER allow the extractor tip to contact the board laminate, conductors or pads.
  - c. The desoldering of lead terminations which are not straight through can be greatly simplified by using micro-miniature tools and techniques.
    - (1) The normal process is to extract all solder possible and then mechanically shear the remaining sweat joint with pliers. The shearing operation presents some risk of workpiece damage.
    - (2) The thermal parting tool may be used in place of the shearing operation. This will greatly reduce the risk of damage.
      - (a) After extracting all the solder possible, adjust the parting tool to solder melting temperatures, and use it to lift (NEVER PRY THE LEAD) the lead to a straight position.
      - (b) When the lead has been lifted, the extractor may be used with the stirring action to completely desolder the lead.
    - (3) The new techniques of solder extraction which apply to micro-miniature repair are those of extensive extractor tip modification to allow desoldering of a wide variety of small sized and odd shaped connections. Remember that you can and should modify your extractor tips to any shape needed when it will result in more efficient solder extraction.

#### 2. Hot air jet

- a. The hot air jet technique is extremely useful for removing lap-soldered component leads. The technique is as follows:
  - (1) Connect the solder extractor to the pressure supply and set the pressure flow control to MINIMUM.

1534

- (2) Adjust the extractor temperature to MAXIMUM, and vary the amount of heat applied to the solder joint by varying the distance between the extractor tip and the joint.
- (3) Gently grip the lead with tweezers and blow hot air on the connection.
- (4) When a solder melt is observed, lift the lead carefully and remove the hot air flow.
- (5) When correct flow, temperature and distance are used, the solder melt should occur in approximately 2 seconds. Remember to alternate the operation from one side of the component to another, so that there is no excessive buildup of heat in a single area.

### 3. Removing welded leads.

#### a. Cutting the lead

- (1) The welded lead is cut between the weld joint and the component body (normally using cutting pliers) being very careful not to damage the pad or welded piece of lead which remains on the pad area.
- (2) The lead must be cut at the edge of the pad area.
- (3) The motor tool may be used to cut the leads when they are not accessible to pliers, but great care must be taken not to cause workpiece damage.

#### b. Dressing the lead

- (1) When the welded component has been cut free and removed, the remaining welded lead ends must be properly dressed and prepared so that a replacement component may be soldered (rather than welded) in place.
- (2) The lead tip is smoothed down flat so that it may serve as a pad area for lap soldering.
- (3) Since most welded leads are gold-plated non-solderable metal, care must be taken not to damage or remove the solderable gold plating from the lead.
- (4) If the lead is unplated, there are two methods of preparation which will allow soldering of a replacement component.



- (a) The unplated lead may be electroplated with gold so that it becomes solderable.
- (b) The welded lead may be removed completely by abrasive methods, and the replacement component lead soldered directly to the pad. This method is the least desirable for two reasons.

1. While completely removing the lead, there is a very high risk of damaging the board circuitry.

2. The pad area must be plated, or the solder joint must be allowed to have a gap on it since the area where the weld was formed will be non-solderable. ✓

- (5) The motor tool can be used to clean and smooth the lead, or to grind away the weld when necessary but must be used with caution to avoid damage.

**NOTE:** NEVER attempt to separate a welded joint with heat or pressure as circuit conductor damage will almost invariable result.

#### E. Evaluating disassembly for completeness and quality.

##### 1. Coating removal - evaluate as follows:

- a. Completeness - check that all coating removal necessary for the entire repair cycle of the workpiece has been performed, and that no part of the remaining coating will interfere with future repair, component mounting, or soldering.
- b. Quality - check that no workpiece damage has been caused, and that all remaining coating is free of charring, cracking or debonding.

##### 2. Desoldering - evaluate as follows:

- a. Completeness - check that all desoldering necessary to the entire repair has been performed, and that all desoldered holes and pads are free of excessive amounts of solder.
- b. Quality - check that no board or conductor damage has been caused.

##### 3. Welded lead preparation - evaluate as follows:

- a. Completeness - check that all leads have been cut, cleaned and smoothed so that they are suitable as a solder pad for replacement components.



- b. Quality.- check that no board or conductor damage has been caused during lead preparation and that any metallic plating (such as gold) is complete and undamaged to permit reliable soldering.
4. Workpiece damage - evaluate any damage found during the previous steps as follows:
- a. Determine if any hidden damage was discovered as a result of disassembly and, if so, incorporate its repair into the overall repair task analysis.
  - b. Determine if any workpiece damage was caused by disassembly and, if so, take the following steps:
    - (1) Evaluate the cause of the damage and take immediate action to insure that similar damage is not caused on future workpieces.
    - (2) Incorporate the necessary repairs into the overall repair task analysis.
- F. Safety precautions.
- 1. Workpiece
    - a. Follow proper workpiece handling procedures at all times.
    - b. In the performance of all work strive to cause no damage and to make as reliable a repair as you are capable of.
  - 2. Tool
    - a. Properly maintain and handle all tools.
    - b. Use all tools ONLY for their intended purpose.
  - 3. Personal - exercise the proper safety precautions for all of the following potentially dangerous items which you will be working with.
    - a. Electrically powered or heated tools
    - b. Edged tools
    - c. Rotating tools
    - d. Caustic, toxic and flammable chemicals and materials.

## ASSIGNMENT SHEET 4-4-1A

TITLE

Micro-electronic Circuit Soldering Techniques

OBJECTIVES

When you complete this lesson topic, you will be able to:

- 4.4.1 POSITION components on micro-electronic printed circuit boards using the preferred mounting procedures outlined in MIL-STD-454D.
- 4.4.2 SHAPE component leads for mounting on micro-electronic printed circuit boards without damaging leads or components and meeting all bend specifications as listed in MIL-STD-454D.
- 4.4.3 REPLACE electronic components on micro-electronic printed circuit boards utilizing the proper tools and soldering techniques for high quality solder connections following the procedures and to the standards as outlined in MIL-STD-454D.
- 4.4.4 INSPECT micro-electronic printed circuit solder connections on selected boards and DETERMINE that their quality and reliability are in accordance with the standards outlined in MIL-STD-454D.
- 4.4.5 IDENTIFY the proper conformal coating that should be applied to various micro-electronic printed circuit boards. Identification will be in complete agreement with the information contained in MIL-C-47256(M.I.).

STUDY ASSIGNMENT

Read and study Notetaking Sheet 4-4-1N of the Student's Guide.

STUDY QUESTIONS

None

1538

## NOTETAKING SHEET 4-4-1M

TITLE

Micro-electronic Circuit Soldering Techniques

REFERENCES

MIL-STD-454D

MIL-S-45743C

MIL-S-46860(MI)

PACE Rework and Repair Technology Series

NOTETAKING OUTLINE

## A. Component preparation

## 1. Preformed leads

- a. Many micro-miniature components today come from the manufacturer with preformed leads.
- b. Preformed leads will greatly ease your job in component preparation but they also require special handling to avoid damaging the lead configuration.

## 2. Specifications and standards

- a. The specifications and standards for round lead components shall be the same as those learned in previous lessons.
- b. The only additions to the specifications apply to flat leads and lap joints. The new specifications are as follows:
  - (1) Leads shall contain two distinct bends at an approximate angle of 45 degrees.
  - (2) The lead shall be in contact with the solder pad from the second bend to the lead tip.
  - (3) The contact area of the lead shall not overhang the edge of the solder pad at any point.
  - (4) The contact area of the lead must be a minimum of 1/2 the length of the solder pad.

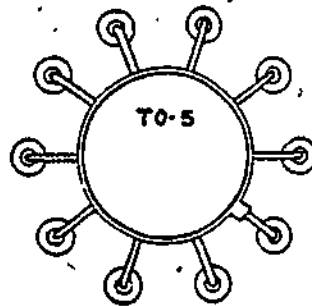
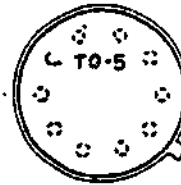
## 3. Recommended forming tools.

- a. There are a large variety of forming tools for multilead components (IC's) which are satisfactory for use. Their cost is generally high, however, since a different forming tool must be used for each lead configuration.

- b. For this reason, hand-forming tools are recommended in most cases.
  - c. All of those tools and techniques learned in previous lessons are recommended for use with micro-miniature components.
  - d. For bending leads of multilead components, the following tools are recommended:
    - (1) Smooth jaw needle nose pliers.
    - (2) Smooth jaw tweezers.
    - (3) Round nose pliers
  - e. Some of the tools used for miniature component lead bending may be too large for the lead size of the micro-miniature components. If so, a tool of the same type but of a smaller size may be used.
4. Hand-forming techniques
- a. All those forming techniques learned in previous lessons are suitable except for the forming of ribbon leads on the "Flat Pack" style of multilead components.
  - b. For bending ribbon leads on the "flat pack" style of multilead components use the following techniques:
    - (1) Grip the leads with needle nose pliers or tweezers with the jaw edge which is nearest the component placed at the point of the first bend.
    - (2) Smoothly and evenly push the component over to a 45 degree angle with your finger. Be careful not to stress the seal of the component during any step of this operation.
    - (3) Grip the leads in the same manner at the point of the second bend.
    - (4) Hold the body of the component between your finger and thumb and smoothly push the component in the opposite direction of the first bend to form the second 45 degree bend.
    - (5) Repeat the previous steps on the other side of the component.

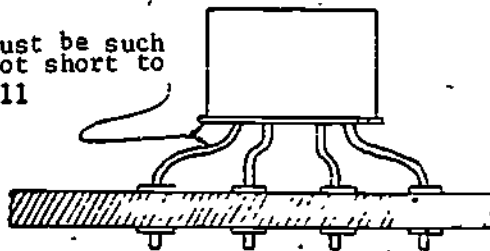
1540

Flat Pack IC

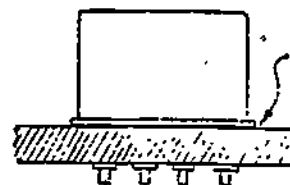
Expanded  
Lead StyleStraight  
Lead Style

Note: All leads not shown.

Lead bend must be such  
that lead does not short to  
rim of metal shell



A transit pad must be  
used when there are con-  
ductors on the component  
side of board to prevent  
metal can from shorting  
runs.



Either style of TO-5 IC lead style may be used with an appropriate transit pad to provide proper lead positioning, lead to case insulation, lead to lead insulation and case to conductor insulation. Transit pad also provides a firm base to prevent component motion.

## 2. Lead terminations

- All of the various lead termination styles you have learned in previous lessons will be found in micro-electronic assemblies.
- In addition to those you are familiar with, there are some new style terminations which are very common to micro-miniature electronic assemblies.
- The first of these is the style used in conjunction with lap-soldered joints.
- The next type is found in some styles of vertical component mounting is called multilead circuit board connections. This is a form of hollow standoff with a solder cup used to connect several leads to the same point.

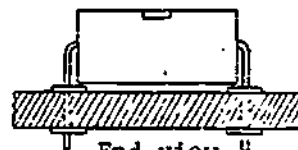
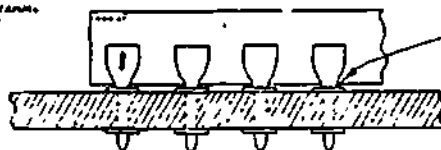
## B. Component installation

### 1. Positioning considerations

- a. Whenever possible, the component should be placed symmetrically between the mounting points and have identifying marks visible.
- b. The prime rule in repair, however, is to always use the same style and positioning as the original, unless it can be shown that greater reliability can be obtained by changing the positioning.
- c. The final positioning consideration which is actually a dictating factor is the actual space provided for the component. This factor is particularly prevalent in micro-miniature electronics where there is often only enough space for the component to be mounted in one way.
- d. Positioning of IC packages depends on which style of package the IC is in. The major styles are:
  - (1) Dual-in-Line,
  - (2) Flat pack
  - (3) TO-5 (can)
- e. The below drawings show the positioning for these three types of packages.

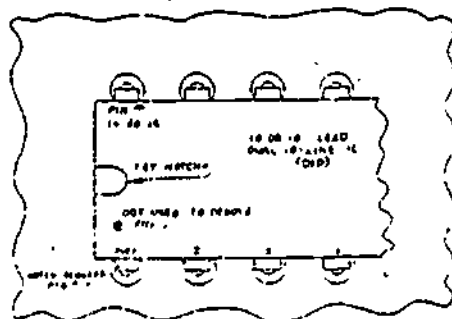
Leads of dip ID's shall be inserted so that shoulder of lead rests on pad.

STAMPED, PLATING  
TO LEAD



End view u

Do n t cut or clinch leads!



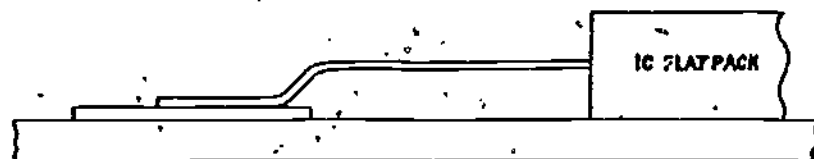
- e. The preferred style of lead termination for through-board solder joints is the straight through termination. This is to allow maximum repairability of the circuits during future maintenance.

### 3. Lead cutting

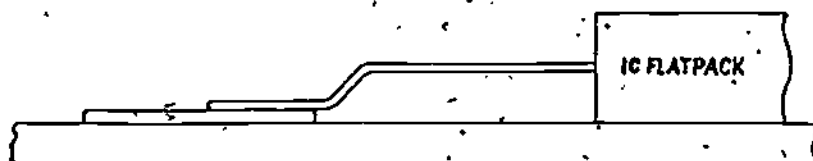
- a. All lead ends must be cut with a flush cutting tool.
- b. Scissors are the most highly recommended tool for cutting flat leads such as those on a flat pack IC, and for cutting the leads on multilead components.
  - (1) Scissors are ideal for cutting the leads of multilead components since they permit all leads to be cut in a single operation. This will provide a high degree of uniformity in lead length.
  - (2) They are also good for flat leads since they allow them to be cut with a minimum amount of torque applied to the lead. This is very important since flat leads are easily distorted by very small amounts of torque.
- c. All other leads may be cut with standard flush cutting pliers.

### 4. Specifications and standards

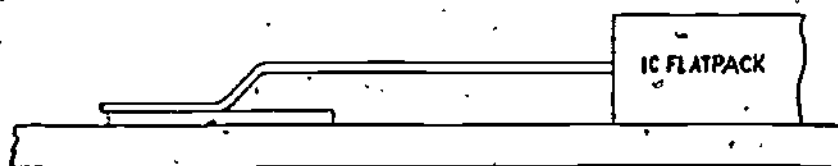
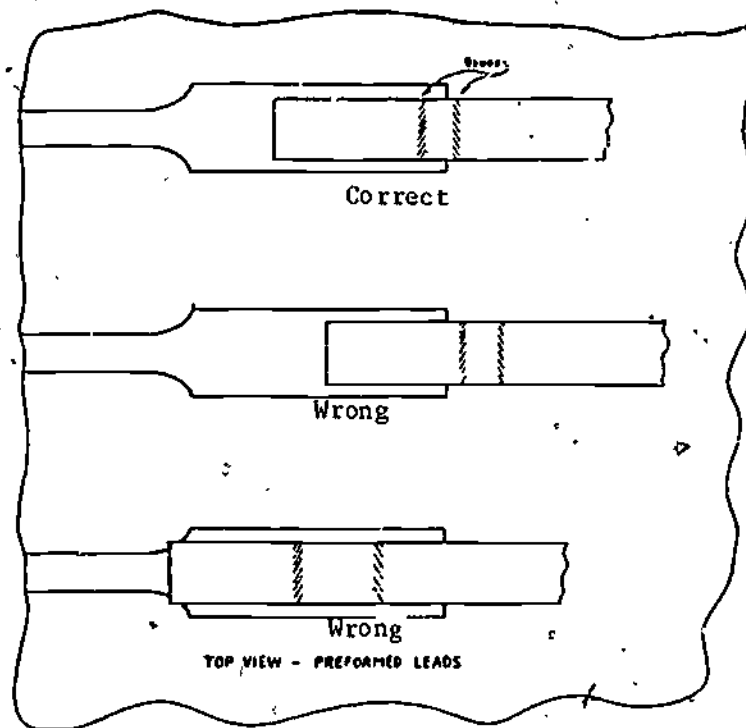
- a. All component mounting and lead termination specifications previously learned apply to micro-miniature electronic repair.
- b. The mounting specifications for an IC may be summed up in one statement, mount it the same as the original. This is because the multilead IC packages do not permit any variation in the physical mounting of the component.
- c. The specifications for a lap-soldered joint lead termination is as follows:
  - (1) The lead must be flush cut, with the cut being perpendicular to the long axis of the lead.
  - (2) No portion of the lead end may extend beyond the edge of the mounting pad.
  - (3) The lead must be flat on the pad surface from the heel of the second bend to the end of the lead.
  - (4) The lead must be centered on the pad surface, with no part of the lead overhanging the pad edges.
  - (5) There must be maximum amount of lead to pad contact.



CORRECT



WRONG

WRONG  
EDGEVIEW - PREFORMED LEADS

Correct

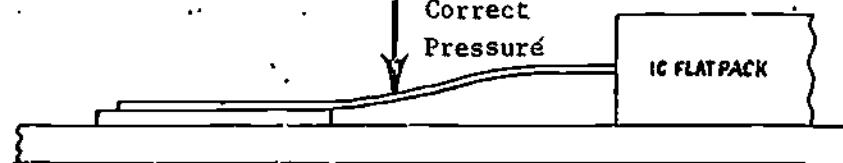
Wrong

Wrong

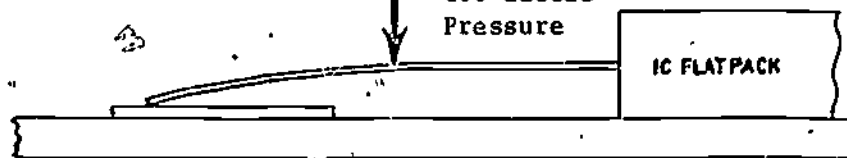
TOP VIEW - PREFORMED LEADS

146

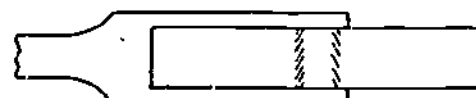
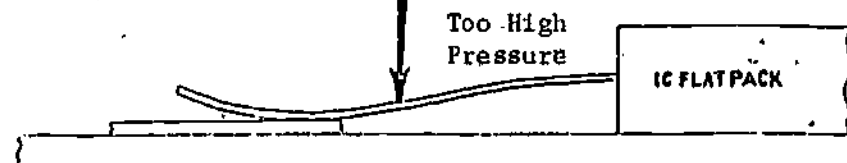
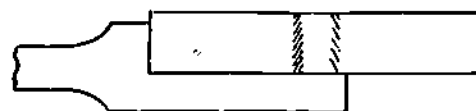
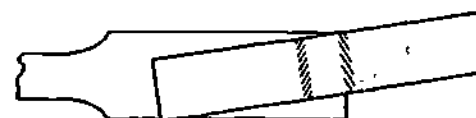
Hold down tool

Correct  
Pressure

CORRECT

Too little  
Pressure

WRONG

Too High  
PressureCorrect position  
top viewWrong position  
top viewWrong position  
top view

1515

IC LEADS



## CURRICULUM

Curriculum research and development has been a predominant activity within marketing and distributive education during the time under study. More than in any other area of research with the profession, there has been a consistent focus and design.

The basic structure of marketing and distributive education curriculum has evolved from a conceptual model presented by Nelson at the 1963 National Clinic on the Implementation of Vocational Education in Distribution. The model identified four occupational competency areas within the discipline of distribution: social skills, basic skills, product or service technology, and marketing skills. In addition to the four competency areas, Nelson identified the need for instruction about the free, competitive enterprise system.

In a U.S. Office of Education publication by Brown (1969), Distributive Education in the High School, the model presented by Nelson was refined and a curriculum outline for analysis of distributive occupations was presented. In that outline, three career levels of distributive occupations were described: basic jobs, career development jobs, and specialist jobs.

That basic curriculum model was modified slightly in a U.S.O.E. publication by Ely (1978), Distributive Education Programs. The revised model described five competency areas. In addition to the four areas described in the 1969 publication, economic concepts of private enterprise was included as a competency area rather than

d. The specifications for a multiple lead termination will be as follows:

- (1) All leads must enter the solder cup on a line parallel to the long axis of the solder cup.
- (2) Lead ends shall be bottomed in the solder cup.
- (3) All lead ends shall be cut to a length so that the lead bend, which is nearest to the solder cup, begins not less than one lead diameter above the top edge of the solder cup when the lead is bottomed in the solder cup.
- (4) All leads entering a solder cup shall have the first bend, which is nearest the solder cup, an even distance above the solder cup in relation to the other leads in that cup.

e. One lead termination standard which you have previously been taught is highly important and should be re-emphasized due to its effect on the repairability of micro-miniature electronic assemblies. The standard pertains to straight through terminations.

- (1) In a straight through termination the lead end must extend a minimum of one lead diameter beyond the board surface and a maximum of two lead diameters.
- (2) The lead end should never be cut flush with the surface of the circuit board (despite the original design) unless a protruding lead end will cause electrical contact with adjacent parts of the assembly or other assemblies.

#### C. High-reliability micro-miniature soldering techniques

##### 1. Through-board soldering

- a. The soldering iron is the most effective tool for making through-board solder joints.
- b. For maximum reliability a through-board solder joint should be completed within 3 seconds after application of heat. This can be accomplished by selecting the proper combination of temperature and tip mass.
- c. A reliable through-board solder joint is formed by using the following techniques:
  - (1) Thoroughly clean all items which will contact or become part of the solder joint.
  - (2) Apply liquid flux to the joint area on both sides of the board.

- (3) Apply the soldering iron tip to contact both the lead and the pad area.
  - (4) Form a heat bridge with clean solder.
  - (5) Apply solder to the connection in sufficient quantity for it to flow through the hole and complete the joint on both sides of the board in a single operation.
  - (6) Thoroughly clean the connection after soldering.
- d. When soldering multilead components, such as IC's, use a skipping pattern to prevent excessive heat buildup in a single area of the board or component.
2. Lap-joint soldering
- a. You are familiar with making lap-soldered connections on circuit conductors using a soldering iron. The use of the special lap flow soldering tool and the installation of lap-soldered ICs will be new to you, however.
  - b. The following steps should be used to reliably form lap-soldered connections:
    - (1) Prior to lap-soldering a connection, the solder pads should be cleaned and pretinned.
    - (2) Component leads should be tinned prior to soldering (particularly if they are gold plated).
    - (3) Properly position the IC on the pad areas, and tack solder two opposite corner leads to their pads to hold the component in place.
    - (4) Apply liquid flux to all connection points and solder each lead in place. Solder will not normally need to be added if the pads are pretinned properly.
    - (5) Do not forget to resolder the two tack soldered corner leads after all other leads have been soldered. Remember, also, to skip around when soldering leads so that there is no excessive heat buildup in any one area.
    - (6) After soldering, thoroughly clean all solder connections.
3. Soldering multiple lead solder cups
- a. Multiple lead connections are soldered with the same techniques as those used on connector pins.

b. Great care must be taken when soldering this type of connection to prevent heat damage since it has a relatively large heat mass which requires considerable heat to do the soldering operation.

c. It is highly recommended that heat shunts be used when soldering this type of connection.

#### D. Use and capabilities of soldering tools.

##### 1. Soldering iron

- a. The soldering iron has the capability of soldering any type of soldered connection.
- b. It is only necessary to learn to select the proper tip and temperature setting to gain this versatility.
- c. Although capable, the soldering iron is not always the easiest and most efficient soldering tool to use. Some special application soldering tools will do the job easier and more efficiently in certain instances.

##### 2. Lap flow soldering tool

- a. The lap flow tool may solder anything from a very tiny strand of wire to a standard flat lead.
- b. The proper use of the lap flow tool in making a lap-soldered connection is as follows:
  - (1) Set the temperature of the lap flow tool (using a practice board) so that the solder on the connection will completely melt in less than 3 seconds.
  - (2) Apply the tip of the tool to the connection to be soldered, using the tip to hold the lead in the proper position.
  - (3) Depress and hold the footswitch until the solder has melted and flowed over the connection (it is permissible to add a small quantity of solder if needed).
  - (4) Keeping the tip in place, release the footswitch and allow the solder to solidify. The lap flow tip is a rapid cooling, non-solderable metal which will not stick to, or damage, the connection.
- c. The tip of the lap flow tool is spring-loaded to prevent excessive pressure from being applied to the joint during soldering.

## E. Solder joint inspection

### 1. Acceptance standards

- a. You have previously learned the acceptance criteria for all types of printed circuit solder joints, except for the lap-soldered connection.
- b. The acceptance standards for lap-soldered connections are as follows:
  - (1) The outline of the component lead must be plainly visible through the solder.
  - (2) The solder must thoroughly cover the pad area, lead surface, lead end and lead edges.
  - (3) A smooth concave fillet must be formed from the pad to the lead and lead edges and the underside or heel of the lead bend closest to the pad.

NOTE: The fillet at the heel of the lead bend provides the majority of the solder connection's strength.

- (4) A smooth gleaming surface finish free of any defects with two exceptions:
  - (a) A depression in the surface of the solder on top of the lead is permissible if the lap flow tool was used to make the connection.
  - (b) Small frosty areas on the surface of the solder are permissible if the lead was gold plated.

### 2. Rejection standards

- a. The rejection criteria for all connections except lap-soldered joints is the same as those you have learned in previous lessons.
- b. The rejection standards for lap-soldered connections are as follows:
  - (1) Insufficient solder which occurs when the concave fillets fall below a line drawn from the pad surface to the top edge of the lead at a 45 degree angle.
  - (2) Excessive solder which occurs if the outline of the component lead is not clearly visible, and if any fillets are convex rather than concave.

1549

- (3) Solder spillage over the edge of the solder pad.
- (4) No fillet on the heel of the lead bend.
- (5) Dewetted areas on any part of the lead or solder pad.
- (6) Excessive frosty appearance of the solder surface on a gold plated lead. This indicates that enough gold is present in the joint to seriously detract from its strength.
- (7) Any evidence of internal solder bonding defects such as pits, cracks, roughness, etc.
- (8) The connection is also unacceptable if the lead bends or positioning is incorrect.

### 3. Visual indications

- a. All of the defects described may be detected visually by the indications described in this lesson and those taught to you in previous lessons.
- b. When visually inspecting micro-miniature solder connections it may often be necessary to use the microscope to reliably check for defects due to the small size of the connection.

## F. Applying conformal coatings

### 1. Surface preparation

- a. There are several thousand different coatings on the market today, and it is totally impractical to try and teach you the proper surface preparation for each type.
- b. The proper requirements for cleaning and preparation should be provided by the manufacturer of each coating and if followed explicitly will give reliable results.

### 2. Application techniques

- a. Coatings may be either sprayed, poured or brushed onto the circuit board.
- b. The type of coating, the desired thickness and the size of the area to be coated will determine which method should be used.
- c. When applying coatings always follow these basic rules:
  - (1) Never apply the coating thicker than the original.

- (2) Never apply a coating of a different type from the original.
- (3) Always apply carefully so there are no bubbles or uncoated spaces in the coating.

### 3. Curing methods

- a. As with preparation methods, there are a multitude of curing methods and it is best to follow the curing directions provided with each coating.
- b. The curing time of nearly all coatings may be speeded up by heat, however, remember that the recommended curing temperature of a coating must NEVER be exceeded, and that a module should not be released from the repair shop until the coating has fully cured.

## G. Safety precautions

### 1. Workpiece

- a. Follow proper workpiece handling procedure at all times.
- b. Never perform an action which will degrade or damage the workpiece.
- c. Perform all work to the best of your capabilities.

### 2. Tool

- a. Properly maintain and handle all tools,
- b. Use all tools only for their intended purpose.

### 3. Personal

- a. Exercise the proper safety precautions for all of the following potentially dangerous items which you will be working with:
  - (1) Electrically powered tools
  - (2) Edged tools
  - (3) Rotating tools
  - (4) Hot tools
  - (5) Caustic, toxic and flammable chemicals and materials.

874

NHB 5300.4(3A)  
(Formerly NPC 200-4)  
MAY 1968  
EDITION

RELIABILITY AND QUALITY ASSURANCE PUBLICATION

**REQUIREMENTS  
FOR  
SOLDERED ELECTRICAL  
CONNECTIONS**



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

1552.



## PREFACE

Date: May 1968

In order to maintain the high standards of the NASA soldering programs, this publication:

1. Prescribes NASA's requirements for hand and machine soldering for reliable electrical connections.
2. Establishes the supplier's responsibility to train and certify personnel.
3. Provides for supplier documentation of those fabrication and inspection procedures to be used for NASA work, including supplier innovations and changes in technology.

## APPLICABILITY

NASA Installations shall:

1. Invoke the provisions of this publication in procurements involving solder connections for aircraft, spacecraft, launch vehicles and mission essential support equipment, and elements thereof as appropriate to design or project needs.
2. Amend, when timely and within cost constraints, existing contracts to invoke the requirements of this publication.
3. Utilize the provisions of this publication for in-house soldering operations and, as necessary, for training and certification of in-house personnel.
4. Furnish copies of this publication in the quantities required to NASA contractors, subcontractors and subtier suppliers.

NASA contractors shall invoke the requirements of this publication in subcontracts and purchase orders.

Questions concerning application of this publication to specific procurements shall be referred to the procuring NASA installation or its designated representative.

876

This publication shall not be rewritten or reissued in any other form.

Copies of this publication are available from the Superintendent of Documents  
U.S. Government Printing Office, Washington, D.C. 20402.

#### SUPERSEDED DOCUMENTS

The following are hereby superseded:

- 1: Quality Requirements for Hand Soldering of Electrical Connections (NPC 200-4). Detailed soldering guidelines formerly covered by NPC 200-4 are published in the Fourth Edition of SP-5002 "Soldering Electrical Connections."
2. NMI 5330.3.
3. NMI 5330.4A.

Any NASA (including NASA installation) document, publication, regulation, etc., inconsistent with the provisions of this NHB 5300.4(3A) is hereby superseded. Also, NASA field installations will comply with the requirements of par. 4b of NPD 1410.1A in this regard.

*John E. Condon*

John E. Condon  
Director  
Reliability and Quality  
Assurance

DISTRIBUTION:  
SDL I (SIQ)

1554

## ORGANIZATION OF THE R&QA MANUAL

### OVERALL COVERAGE

The Reliability and Quality Assurance Manual--referred to as the "R&QA Manual"--is the overall generic title which identifies all NASA R&QA management publications published under the basic R&QA subject classification code. The publications are grouped by major subject breakdown and further divided into specific categories identified as Parts. These Parts (not a complete R&QA Manual) are published as individual R&QA publications.

The following list shows the grouping and initial plan for publishing the individual R&QA publications:

<u>Part</u>	<u>Title</u>	<u>Assigned no.</u>
<u>Volume 1 - General Provisions</u>		
A	Reliability Program Requirements	_____
B	Quality Program Requirements	_____
<u>Volume 2 - Government Agency Provisions</u>		
A	Management of Government Quality Assurance Functions for Supplier Operations	_____
B	Quality Assurance Requirements	_____
<u>Volume 3 - Standards</u>		
A	Requirements for Soldered Electrical Connections (Formerly NPC 200-4)	NHB 5300.4(3A)

### DOCUMENT REFERENCING

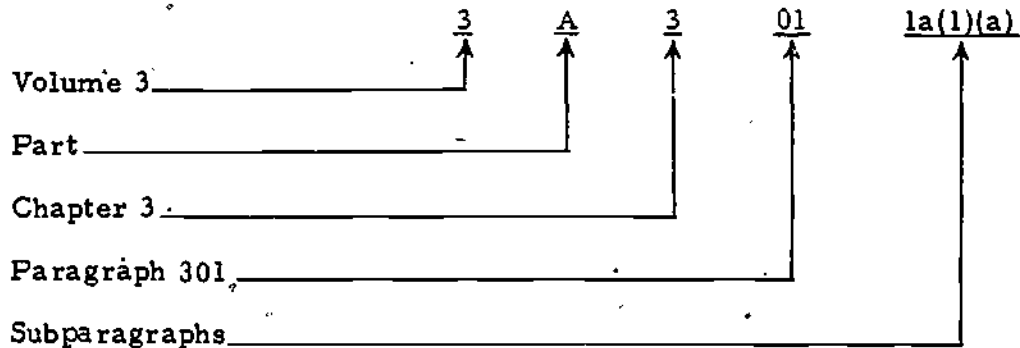
Each R&QA Manual Part is assigned its own identification number within the basic classification code. The numeric-alpha suffix within a parenthesis identifies the grouping of the publication, that is, the volume and part, such as NHB 5300.4(3A): this number indicates that this is the first "Standards" (Volume 3) publication to be issued.

When a part is revised, the suffix identification will be changed to indicate the revision number such as NHB 5300.4(3A-1).

In referencing or requesting any R&QA publication, the complete specific NHB number must be used.

## PARAGRAPH REFERENCING

1. Within the R&QA Manual. The following shows the paragraph numbering system applicable to all R&QA publications.



This system provides for referencing any R&QA publication requirement (paragraph) in any other R&QA publication without the need for identifying the NHB number, title, the volume number, or part. However, when referencing a complete Part within another R&QA publication, the specific NHB number must be used.

2. In Other NASA Documents. When it is necessary to reference an R&QA publication requirement (paragraph) in any other NASA document, the specific NHB number and paragraph number must be used together as follows: "NHB 5300.4(3A), par. 3A301-1a(1)(a)," or "paragraph 3A301-2b of NHB 5300.4(3A)."

## TABLE OF CONTENTS

<u>Par.</u>		<u>Page</u>
Chapter 1: BASIC PRINCIPLES		
3A100	Scope .....	1-1
3A101	General .....	1-1
3A102	Related Documents .....	1-2
3A103	Deviation and Waiver Requests .....	1-2
3A104	Rework .....	1-2
CHAPTER 2: SUPPLIER SOLDERING PROGRAM		
3A200	General .....	2-1
3A201	Training and Certification .....	2-1
3A202	Maintenance of Certified Status .....	2-1
3A203	Recertification .....	2-1
3A204	Revocation of Certified Status .....	2-2
3A205	Vision Requirements .....	2-2
3A206	Workmanship Standards .....	2-2
3A207	Document Submittal .....	2-3
CHAPTER 3: FACILITIES, EQUIPMENT AND MATERIALS		
3A300	Facility Cleanliness .....	3-1
3A301	Environmental Conditions .....	3-1
3A302	Lighting Requirements .....	3-1
3A303	Tool and Equipment Control .....	3-1
3A304	Heat Sources .....	3-1
3A305	Conductor Preparation Tools .....	3-2
3A306	Thermal Shunts .....	3-2
3A307	In-Process Storage and Handling .....	3-2
3A308	Materials Selection .....	3-3
3A309	Solder .....	3-3
3A310	Flux .....	3-3
3A311	Solvents .....	3-3
3A312	Terminals .....	3-4
CHAPTER 4: PREPARATION FOR SOLDERING		
3A400	Preparation of Conductors .....	4-1
3A401	Preparation of Terminals and Solder Cups .....	4-1
3A402	Additional Requirements .....	4-1
CHAPTER 5: PARTS MOUNTING		
3A500	General Requirements .....	5-1
3A501	Lead Bending Requirements .....	5-1
3A502	Lead Clinching, Printed Wiring Boards .....	5-2

Par.		Page
3A503	Mounting of Parts to Terminals .....	5-3
3A504	Cordwood Modules.....	5-3
3A505	Mounting of Flat Pack Circuits .....	5-3

#### CHAPTER 6: ATTACHMENT OF CONDUCTORS TO TERMINALS

3A600	General .....	6-1
3A601	Wire Termination.....	6-1
3A602	Turret and Straight Pin Terminals .....	6-2
3A603	Bifurcated Terminals.....	6-2
3A604	Hook Terminals .....	6-5
3A605	Pierced Terminals .....	6-7
3A606	Solder Cups (Connector Type).....	6-7
3A607	Solder Cups (Swaged Type).....	6-7
3A608	Connection Without Terminals .....	6-7
3A609	Lap Joints.....	6-7
3A610	Insulation Tubing Application.....	6-7

#### CHAPTER 7: SOLDERING OF TERMINALS

3A700	General .....	7-1
3A701	Solder Application.....	7-1
3A702	Removal of Flux and Residue.....	7-1
3A703	Inspection .....	7-2
3A704	Acceptance Criteria.....	7-2
3A705	Rejection Criteria .....	7-2

#### CHAPTER 8: PRINTED WIRING ASSEMBLY SOLDERING

3A800	Fabrication and Conformal Coating.....	8-1
3A801	General Requirements.....	8-1
3A802	Printed Wiring Board Protection.....	8-1
3A803	Terminal Soldering.....	8-1
3A804	Preparation and Soldering of Termination Areas.....	8-2
3A805	Inspection .....	8-2
3A806	Acceptance Criteria.....	8-2
3A807	Rejection Criteria .....	8-3

#### CHAPTER 9: AUTOMATIC MACHINE SOLDERING

3A900	General .....	9-1
3A901	Documentation .....	9-1
3A902	Preparation and Assembly .....	9-1
3A903	Machine Requirements .....	9-2
3A904	Cleaning .....	9-2
3A905	Inspection.....	9-2

#### APPENDIXES

Appendix A: Definitions .....	a-1
Appendix B: Typical Satisfactory and Unsatisfactory Solder Connections.....	b-1

## CHAPTER 1: BASIC PRINCIPLES

### 3A100 SCOPE

1. This publication sets forth hand and machine soldering requirements for reliable electrical or electronic connections. For the purposes of this document, the definitions in Appendix A shall apply.
2. This publication does not include specific requirements or specifications for the subjects listed below; however, these subjects are discussed in the paragraphs indicated as they relate to the requirements of this document. Contracts and purchases citing this publication shall contain detailed requirements to cover these items where applicable, including provisions for materials and applications suited to the intended use and environment.

Special storage and handling (par. 3A307)

Wire insulations, sleeving (par. 3A308, 3A610)

Ultrasonic cleaning (par. 3A311)

Terminals (par. 3A312)

Special parts mounting requirements (par. 3A500)

Potting compounds (par. 3A504)

Cordwood modules (par. 3A504)

Integrated circuits (par. 3A505)

Connection without terminals (par. 3A608)

Printed wiring (par. 3A800)

Conformal coating (par. 3A800)

Magnification (par. 3A703, 3A805, 3A905)

Clean room requirements

### 3A101 GENERAL

1. NASA quality assurance personnel will advise and assist contractors, suppliers, NASA personnel and delegated agencies in the proper and effective implementation of the provisions of this document.



- 282 2. Where related requirements or changes in requirements are required, NASA quality assurance personnel will insure that the Government agency delegated to inspect at the supplier's site of fabrication has received full instructions so that the work will be inspected to the actual contract requirements.
3. Unless parts are fabricated specifically to comply with contracts or subcontracts citing this publication, internal connections of parts (as parts are defined in Appendix A) are not subject to the requirements of this publication. The supplier should assure himself that parts have suitable internal connections which will not unsolder or deteriorate when external connections are made by his processes.

### 3A102 RELATED DOCUMENTS

1. APPLICABLE SPECIFICATIONS. Copies of the following applicable specifications required in connection with a specific procurement may be obtained from the procuring NASA Installation or as directed by the contracting officer:

QQ-S-571 - Solder, Tin Alloy; Lead Tin Alloy; and Lead Alloy.

MIL-F-14256 - Flux, Soldering, Liquid (Rosin Base).

Unless otherwise specified, the issue in effect on the date of invitation for bids or request for proposal shall apply.

2. REFERENCE PUBLICATION. The Fourth Edition, NASA SP-5002 "Soldering Electrical Connections," contains many detailed suggestions and techniques on how to satisfy the requirements of this publication. SP-5002 is available for purchase at 30¢ per copy from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. NASA personnel should order copies through their installation technical library.

### 3A103 DEVIATION AND WAIVER REQUESTS

This publication requires:

1. Written approval of the cognizant NASA contracting officer or his designated NASA representative, for technical changes, deviations or waivers.
2. All deviation and waiver requests shall be supported by objective evidence and data substantiating that quality will not be compromised.

### 3A104 REWORK

Rework, as defined in Appendix A, is permissible unless excluded by other provisions of the contract. All rework shall meet the requirements of this publication. Rework is not repair. Repair shall be made only in compliance with applicable contractual requirements.



## CHAPTER 2: SUPPLIER SOLDERING PROGRAM

### 3A200 GENERAL

The supplier is responsible for maintaining a documented soldering program which meets the requirements of this publication for the types of solder connections utilized in the articles involved. Portions of this publication, including illustrations, may be abstracted for the program.

### 3A201 TRAINING AND CERTIFICATION

The supplier is responsible for:

1. Providing necessary training of his personnel in the use of equipment employed and for insuring that all personnel who perform or inspect soldering are adequately skilled to fabricate the types of soldered connections required.
2. Certifying all personnel who perform or inspect soldering as being currently qualified to fulfill all requirements of this publication pertaining to the types of connections to be soldered. Records or evidence of certification status shall be maintained in the work area.
3. Maintaining appropriate records of training, including the certification criteria for each individual's latest certification.

### 3A202 MAINTENANCE OF CERTIFIED STATUS

1. The procuring Installation or its designated representative, or the supplier's instructor, may require supplier soldering personnel to demonstrate proficient workmanship on applicable hardware, or to be recertified.
2. The procuring Installation or its designated representative or the supplier's instructor, may require supplier inspection personnel to demonstrate proficient inspection performance and knowledge on applicable hardware or to be recertified.

### 3A203 RECERTIFICATION

1. The need for recertification shall be based on observation of the unsatisfactory quality of articles fabricated, or interruption of work period for more than 30 days.
2. Recertification shall be required when:
  - a. Proficiency requirements herein are not met.
  - b. New techniques have been developed which require different skills.

- c. Certificate holder changes employment.
  - d. There is reason to question workmanship of operators or inspection performance by inspectors.
3. Procedures for recertification shall include sufficient training or retraining to enable the candidate to demonstrate proficiency in fabricating or inspecting the types of solder connections involved in his assigned work. A proficiency demonstration shall be required of each candidate.

### 3A204 REVOCATION OF CERTIFIED STATUS

Certifications shall be revoked for operators or inspectors when:

- 1. Certificate holder requires recertification according to paragraph 3A203 and fails to be recertified.
- 2. Supplier training program fails to meet requirements as set forth herein or as set forth otherwise in the contract.
- 3. Certificate holder leaves employment.
- 4. Certificate holder fails to meet visual acuity requirements of paragraph 3A205.

### 3A205 VISION REQUIREMENTS

- 1. The supplier is responsible for ensuring that all personnel who perform soldering or inspect soldered connections meet the following vision test requirements as prerequisite to training and to certification and recertification. The vision requirements may be met with corrected vision (personal eye glasses). The eye tests shall be administered by qualified personnel, using standard instruments and techniques. Results of the vision examination shall be maintained and available for review.
- 2. The following are the minimum vision requirements:
  - a. Far vision. Snellen Chart 20/50.
  - b. Near vision. Jaeger 1 at 14 inches; or reduced Snellen 20/20 or equivalent.
  - c. Color vision. Ability to distinguish red, green, blue and yellow colors as prescribed in Dvorine Charts, Ishihara Plates, or AOD-HRR Tests. A practical test, using color coded wires and/or color coded electrical parts as applicable, will be acceptable for color vision testing.

### 3A206 WORKMANSHIP STANDARDS

The supplier shall:

- 1. Prepare visual standards consisting of satisfactory work samples or visual aids which clearly illustrate the quality characteristics for all soldered connections involved.

2. Utilize applicable illustrations in this publication, supplemented <sup>885</sup> as necessary for visual standards.
3. For approved connections other than those illustrated herein, prepare appropriate visual standards.
4. Clearly illustrate by these standards preferred workmanship and the difference between acceptable and unacceptable workmanship.
5. Make applicable visual standards readily available to concerned personnel and use them in the training program.
6. Use these standards for inspection criteria and evaluation of personnel performance.

### 3A207 DOCUMENT SUBMITTAL

1. Documents required herein shall be submitted to the procuring NASA Installation or its designated representative for review. Applicable supplier soldering program documents, or portions thereof, accepted on other NASA contracts shall be included to avoid duplication of effort.
2. The supplier shall describe the training and certification program he proposes to satisfy the requirements herein for the types of solder connections he will make. This description shall include the following, as applicable:
  - a. Qualifications of instructors
  - b. Procedures for training
  - c. Lesson plan(s)
  - d. Hours of instruction
  - e. Procedures for certification and recertification.
3. The supplier shall document the fabrication and inspection procedures he proposes to satisfy the requirements of this publication.

## CHAPTER 3: FACILITIES, EQUIPMENT AND MATERIALS

### 3A300 FACILITY CLEANLINESS

The supplier is responsible for maintaining soldering areas in a clean orderly condition. Smoking, eating and drinking at the work stations shall not be permitted.

### 3A301 ENVIRONMENTAL CONDITIONS

1. The soldering area shall have a controlled environment which limits entry of contamination. This area shall be continuously controlled as follows:

Temperature .....  $75^{\circ} \pm 10^{\circ} \text{ F}$   
Relative Humidity..... Max. 60%

2. In field operations, and where soldering under controlled conditions is impractical, adequate precautions shall be taken to maintain the required quality of solder connections.

### 3A202 LIGHTING REQUIREMENTS

Light intensity shall be a minimum of 100 foot-candles on the work surface.

### 3A303 TOOL AND EQUIPMENT CONTROL

The supplier shall:

1. Select tools and equipment used in soldering, and in preparations thereto, for intended function.
2. Properly clean and maintain equipment and tools.
3. Document or reference, in the supplier's soldering program, detailed operating procedures and maintenance schedules for tools and equipment requiring calibration or set-up.
4. Maintain records of tool calibration and verification.

### 3A304 HEAT SOURCES

1. SUPPLIER RESPONSIBILITY. The supplier shall:

- a. Choose a means of applying heat to the metals to be joined that is compatible with the size, shape, and thermal conductivity of the work pieces.
- b. Provide in operating procedures for cleanliness of the heat source to ensure uniform heat transfer and prevent contamination of the solder connection.
- c. Forbid use of soldering guns.

2. RESISTANCE-TYPE SOLDERING ELECTRODES. The surfaces of electrodes shall be kept free of dirt and corrosion.
3. CONDUCTION-TYPE IRONS. The tip shall be periodically checked for:
  - a. Proper insertion.
  - b. Tight attachment.
  - c. Cleanliness.
  - d. No oxidation scale between tip and heat element.
  - e. Continuously tinned surface on the tip working surface to insure proper heat transfer and to prevent transfer of impurities.
4. NONCONTACT HEAT SOURCES. When soldering heat is applied by a jet of heated gasses, or by radiant energy beams, the supplier shall set up, operate, and maintain the equipment by established, documented procedures.

### 3A305 CONDUCTOR PREPARATION TOOLS

The supplier shall select and use conductor preparation tools as follows:

1. Select insulation strippers and lead bending tools which do not nick, ring, gouge or scrape conductors or damage parts.
2. Select part lead cleaning tools which do not damage leads and parts and which do not cause contamination and hinder solder wetting.
3. Use the correct size of stripping tools or machines and maintain them in calibration.
4. Verify, periodically, insulation strippers and lead bending tools for proper operation.
5. Remove defective or uncalibrated tools and strippers promptly from the work area.

### 3A306 THERMAL SHUNTS

Thermal shunts shall be utilized where heat from the soldering operation may degrade the quality of heat sensitive parts or of previously soldered connections.

### 3A307 IN-PROCESS STORAGE AND HANDLING

The supplier is responsible for proper storage and handling and providing means to prevent contamination of printed wiring termination areas, terminals, wire ends, or part leads during handling and storage. Containers compatible with materials stored are required. When handling of bare copper surfaces is unavoidable, white gloves or finger cots shall be used.

## 888 3A308 MATERIALS SELECTION

The supplier is responsible for selecting materials suitable for intended use which do not degrade the quality of the solder junction, and metals or parts being joined.

### 3A309 SOLDER

Solder shall conform to Federal Specification QQ-S-571, Type RA or RMA for cored solder; and type S, form B or I for solid solder, and shall be composition Sn60 - Sn63, unless otherwise required by a NASA approved design.

### 3A310 FLUX

1. TYPES AND USAGE. The supplier's process documentation shall describe the types of fluxes, where each is used, and necessary precautions.
2. LIQUID ROSIN FLUX. Liquid rosin flux shall conform to MIL-F-14256, Type A, except that the copper mirror test (par. 3.5) is not required, and that the resistivity of water extract (par. 3.2.6) shall be at least 45,000 ohm-centimeters. Liquid flux used with flux-cored solder shall be chemically compatible with the solder core flux and with the materials with which it will come in contact.

### 3A311 SOLVENTS

1. Solvents and processes proposed by the supplier for cleaning and flux removal shall be submitted for review. Solvents shall be non-conductive, noncorrosive, and shall not dissolve or degrade the quality of parts or materials.

#### CAUTION!

Solvents shall not be used in any manner which will carry dissolved flux residue on to contact surfaces such as those in switches, potentiometers, or connectors.

2. The following solvents are acceptable when properly used for cleaning in soldering operations:
  - a. Ethyl alcohol, ACS grade, 99.5% or 95% by volume.
  - b. Isopropyl alcohol, best commercial grade, 99% pure.
  - c. Trichlorotrifluoroethane, clear, 99.8% pure.
  - d. Any mixtures of the above.

#### CAUTION!

Ultrasonic cleaning, if used, shall be employed with caution to prevent damage to parts.

1. Solder terminals shall comply with the contractual specification or drawing.
2. Hot dipped, tin-lead coated terminals are preferred. Terminals with uneven or excessive coating on the mounting surfaces shall not be used as they may loosen in subsequent soldering operations.
3. Terminals shall be of proper size to accommodate the conductors. Terminals and conductors shall not be modified to accommodate improper sizes.



## CHAPTER 4: PREPARATION FOR SOLDERING

### 3A400 PREPARATION OF CONDUCTORS

1. INSULATION REMOVAL. Stripping tools or machines used shall be of the correct size for the wire used and in current adjustment and/or calibration.
2. DAMAGE TO INSULATION. After insulation removal or stripping, wires shall be examined for damage such as crushing or charring. Wires with damaged insulation shall not be used. Slight discoloration from thermal stripping is acceptable.
3. DAMAGE TO CONDUCTORS. After stripping, wires shall be examined to insure that the strands have not been nicked, cut, scraped, or otherwise damaged. Damaged wires shall not be used.
4. WIRE LAY. The lay of the wire strands shall be restored if disturbed, without using bare finger contact.
5. CONDUCTORS. Conductors or part leads shall not be reduced in cross-sectional area. Part leads or solid wires shall be pretinned and shall be cleaned immediately prior to attaching. No solvent shall be permitted under the insulation. Flux shall be applied so that it does not go under the insulation except for traces carried up by solder wicking.
6. TINNING OF STRANDED CONDUCTORS. Stripped ends of stranded wires shall be tinned to prevent untwisting and separation of wire strands.
7. WICKING. Flow (wicking) of solder along the conductors is permitted but shall not obscure the wire contour at the termination end of the insulation.

### 3A401 PREPARATION OF TERMINALS AND SOLDER CUPS

Terminals shall be examined and cleaned when necessary immediately prior to attachment of conductors.

### 3A402 ADDITIONAL REQUIREMENTS

1. SOLID HOOKUP WIRE. Solid hookup wire shall not exceed a length of one inch between supports. For wires over one inch in length, attachment to a surface by conformal coating is adequate support.
2. STRESS RELIEF. Each conductor terminating at a connection point shall have an allowance for stress relief to minimize tensile or shear stress to the soldered connection or part during thermal expansion.
3. MECHANICAL SUPPORT. Wire bundles shall be supported so that the soldered connections are not subjected to mechanical loads.
4. SPLICES. Conductors shall not be spliced except as authorized by the procuring NASA Installation.



## CHAPTER 5: PARTS MOUNTING

## 3A500 GENERAL REQUIREMENTS

1. Unless otherwise specified or approved by the procuring NASA Installation, parts shall be mounted parallel to, and in contact with the mounting surface.
2. IRREGULARLY SHAPED PARTS. When the shape of parts is such that only point contact can be made with the mounting surface, additional support shall be provided.
3. HEAVY PARTS. Parts which weigh more than 1/2 ounce (14 grams) shall be supported. Design requirements shall specify method of support or attachment.
4. METAL CASE PARTS. Metal cased parts mounted over printed conductors, or which can come in contact with each other or with other conductive material, shall be encased in transparent insulation. Such parts shall not be mounted over solder connections.
5. GLASS ENCASED PARTS. Glass encased parts (such as diodes) shall be enclosed in transparent resilient sleeving or coating material when epoxy material is used for support, conformal coating, or potting.

## 3A501 LEAD BENDING REQUIREMENTS

1. GENERAL. During bending or cutting, part leads shall be supported to minimize axial stress and avoid damage to seals or internal bonds. The inside radius of bend shall not be less than the lead diameter. The distance from the bend to the end seal shall be approximately equal at each end of the part. The minimum distance shall be two lead diameters. The direction of the bend shall not cause the marking on the mounted part to be obscured. Where the lead is welded (as on a tantalum capacitor) the minimum distance is measured from the weld. (See Figure 5-1).

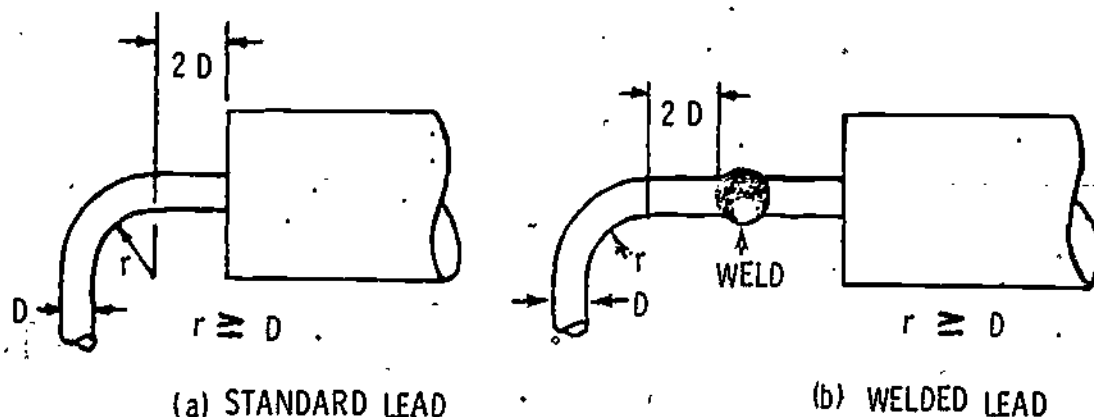


FIGURE 5-1--MINIMUM LEAD BEND

- 892 2. **NONBENDABLE LEADS.** Leads which cannot be bent shall be cut so that when mounted, the leads protrude through the board from 1/32" to 3/32". The contour of the end of the conductor shall be discernible after soldering. (See Figure 5-2.)

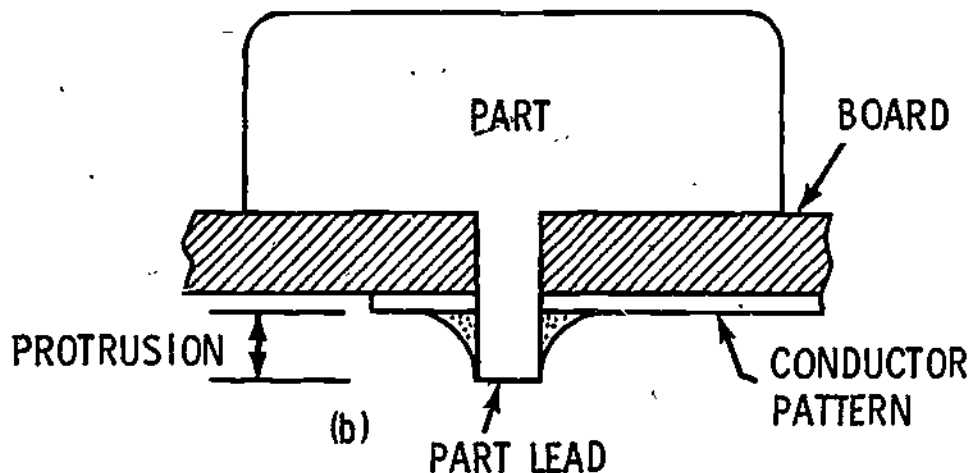


FIGURE 5-2--NONBENDABLE LEADS

### 3A502 LEAD CLINCHING, PRINTED WIRING BOARDS

1. **GENERAL.** The clinched lead shall not extend beyond the conductor pattern edge. The clinch shall not be forced to make the conductor lie flat at the bend radius. The innate springback of the part lead is acceptable. (See Figure 5-3.)

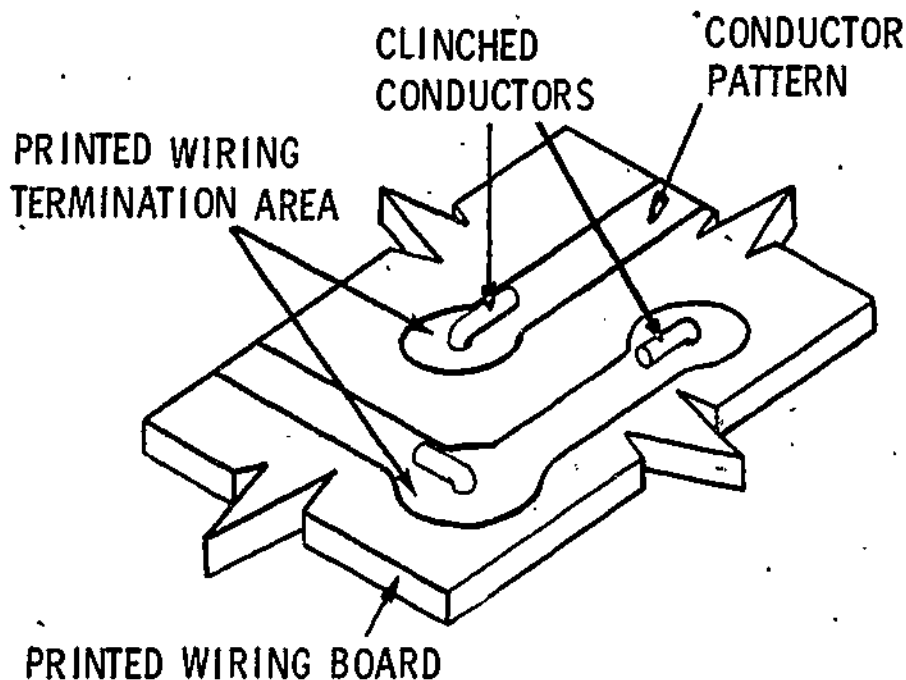


FIGURE 5-3.-EXAMPLE OF CLINCH DIRECTION

2. ROUNDED TERMINATION AREAS. The leads shall extend through the board a minimum of the termination-area radius, and a maximum of two times the termination-area radius, and shall be clinched in the direction of the conductor pattern.
3. IRREGULARLY SHAPED TERMINATION AREAS. For irregularly shaped termination areas, such as for shield and ground plane connections, the minimum clinch lead length shall be twice the diameter of the lead hole, and the maximum shall be four times the hole diameter.

### 3A503 MOUNTING OF PARTS TO TERMINALS

1. The length of leads between parts, and terminals shall be approximately equal at both ends, except when special part shapes, such as flanges on tophat diodes, requires staggering.
2. Each lead shall have provision for stress relief.
3. Degree of wrap, routing, and connection to terminals are specified in Chapters 6 and 7.

### 3A504 CORDWOOD MODULES

1. Parts in cordwood modules shall be mounted with the part axis perpendicular to the two parallel printed wiring boards.
2. Tubular parts shall be uniformly spaced between the printed wiring boards.
3. Coated parts shall be mounted so that coating on leads does not enter the mounting hole.
4. Termination of part leads shall be as specified herein, except when they are extended to serve as straight pin terminals (see paragraph 3A608), or as connections to the board on which the module is mounted.
5. Leads of heat sensitive parts shall not be used as straight pin terminals.
6. The selection and application of potting compound and the use of clinched or unclinched lead terminations shall be as approved by the procuring NASA Installation.

### 3A505 MOUNTING OF FLAT PACK CIRCUITS

1. The requirements of paragraph 3A502 shall not apply to the mounting of integrated circuit packages of the configuration known as "flat packs." Mounting may be on the wiring side of the boards, by lap solder joints to termination areas. Any bending of leads shall be done on suitable fixtures to prevent damage to seals.
2. Internal connections shall be suited to the intended use and environment and are not subject to the requirements of this publication.

## CHAPTER 6: ATTACHMENT OF CONDUCTORS TO TERMINALS

### 3A600 GENERAL

1. Conductors shall be attached to terminals as illustrated in this section, which shows the requirements for routing to terminals, terminal fill, insulation clearance, and the extent of conductor wrap or bend.
2. For terminals not described or illustrated herein, similar procedures to accomplish the same intent shall be documented and submitted by the supplier for review by the procuring NASA Installation.

### 3A601 WIRE TERMINATION

1. BREAKOUTS FROM CABLES. For multiple wires routed from a common cable trunk to equally spaced terminals, the length of the wire ends, including vibration bend allowance shall be uniform to prevent stress concentration on any one wire.
2. MINIMUM INSULATION CLEARANCE. The insulation shall not be imbedded in the solder joint. The contour of the conductor shall not be obscured at the termination end of the insulation.
3. MAXIMUM INSULATION CLEARANCE. The maximum insulation clearance shall be less than two wire diameters including insulation but in no case shall permit shorting between adjacent conductors.
4. MULTIPLE PARALLEL ENTRY. For multiple parallel entry of wires to a terminal, insulation clearances need not be equal.
5. VARIATIONS. When characteristic impedance or circuit parameters are affected, such as in high voltage circuits or coaxial line terminations, the insulation clearance requirements may be modified. All variations shall be documented in the process procedures.

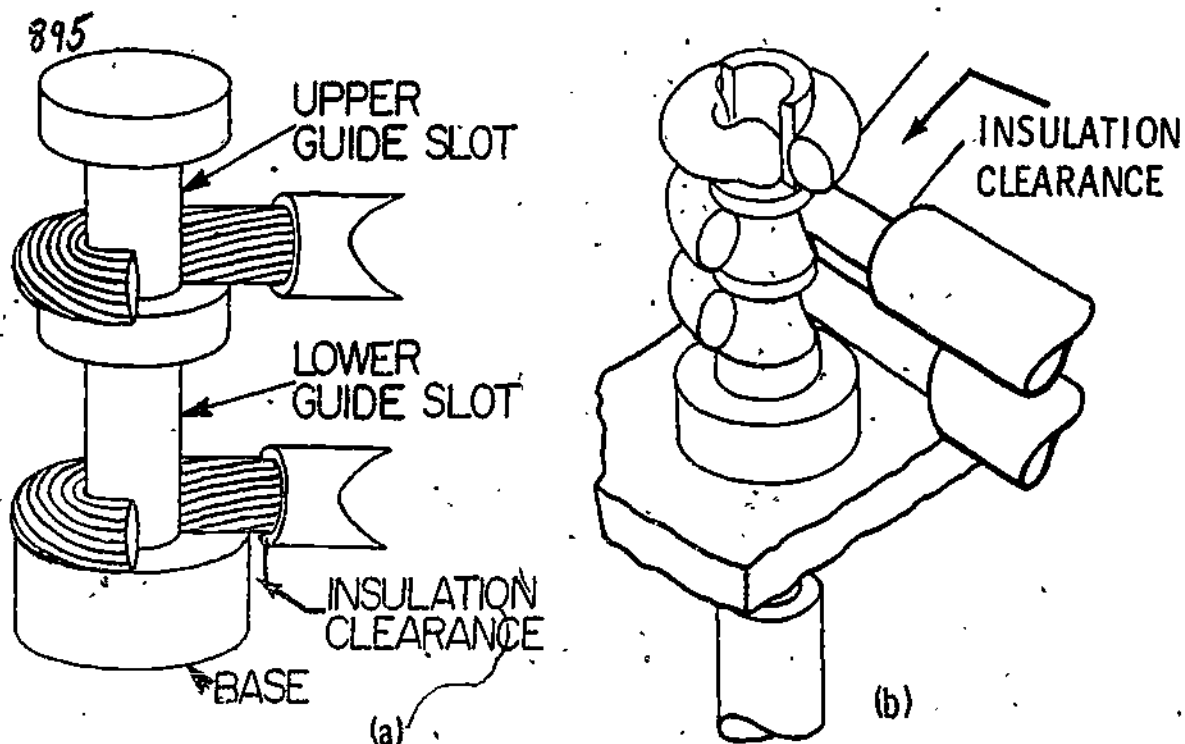


FIGURE 6-1-SIDE AND BOTTOM ROUTE CONNECTION TO TURRET TERMINALS

### 3A602 TURRET AND STRAIGHT PIN TERMINALS

1. SIDE ROUTE. The side route shall be connected as follows (see Figure 6-1 (a)):
  - a. Conductor sizes AWG 26 and smaller shall be wrapped a minimum of 1/2 turn to a maximum of one full turn around the post.
  - b. Conductor sizes larger than AWG 26 shall be wrapped a minimum of 1/2 to a maximum of 3/4 turn around the post.
  - c. For turret terminals, all conductors shall be confined to the guide slots.
2. BOTTOM ROUTE. The conductor shall enter the terminal from the bottom, be brought through the side slot at the top, and wrapped as required for side route, see Figure 6-1 (b).

### 3A603 BIFURCATED TERMINALS

1. GENERAL. Top, side, or bottom routes, or combinations as illustrated in this chapter are permissible. Terminal side route connections shall not extend beyond the top of terminal.

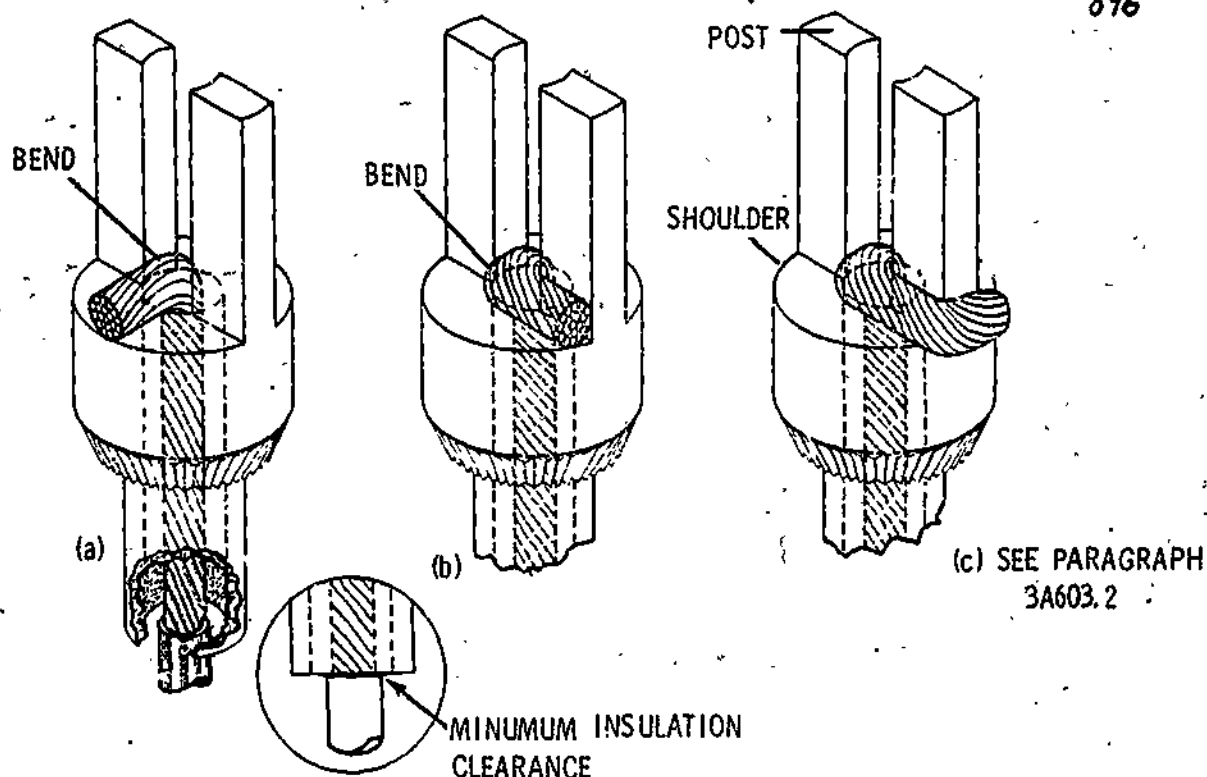


FIGURE 6-2--BOTTOM ROUTE CONNECTIONS TO BIFURCATED TERMINAL

2. **BOTTOM ROUTE.** Bottom route shall be connected as shown in Figure 6-2. Conductors shall not extend beyond the diameter of the base except as shown in Figure 6-2 (c), which is acceptable only when physical clearance is adequate for the intended environment and electrical characteristics.
3. **SIDE ROUTE.** Side route shall be connected as shown in Figure 6-3. The conductor shall enter the mounting slot perpendicular to the posts. When more than one conductor is connected to a terminal, the direction of bend of each additional conductor shall alternate. Conductors shall not extend beyond the diameter of the base except as shown in Figure 6-3(c), which is acceptable only where physical clearance is adequate for environment and electrical characteristics.
4. **TOP ROUTE.** Top route shall be connected as shown in Figure 6-4. Conductors which fill the gap between vertical posts shall be inserted to the depth of the shoulder. Conductors which do not fill the gap shall be accompanied by a tinned filler wire (solid or stranded) to help hold the conductor in position or shall be

897

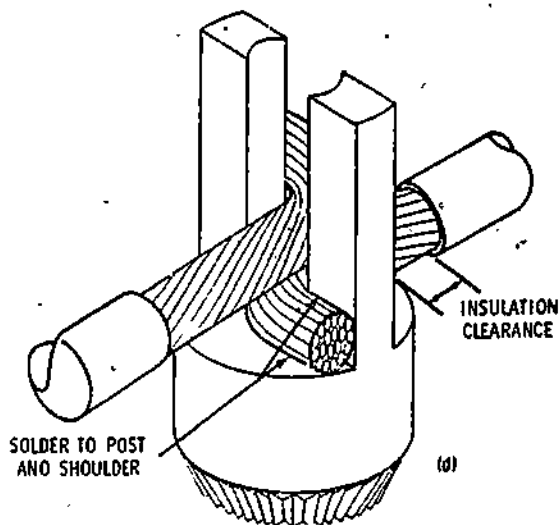
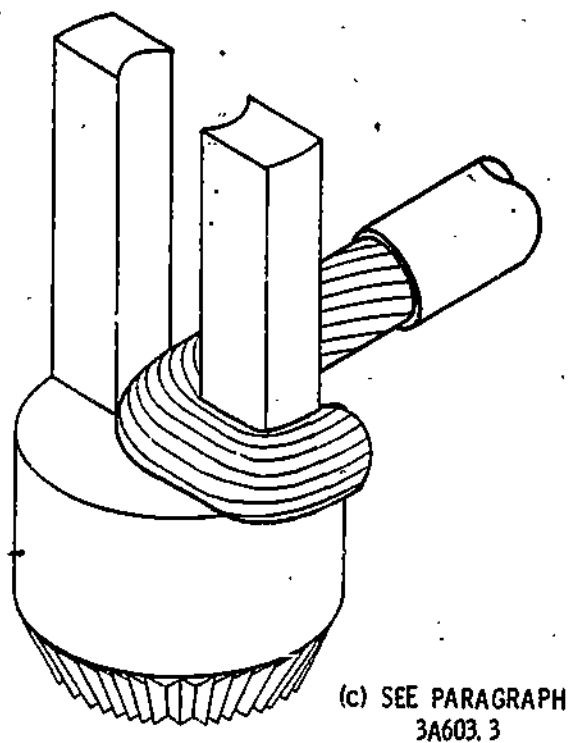
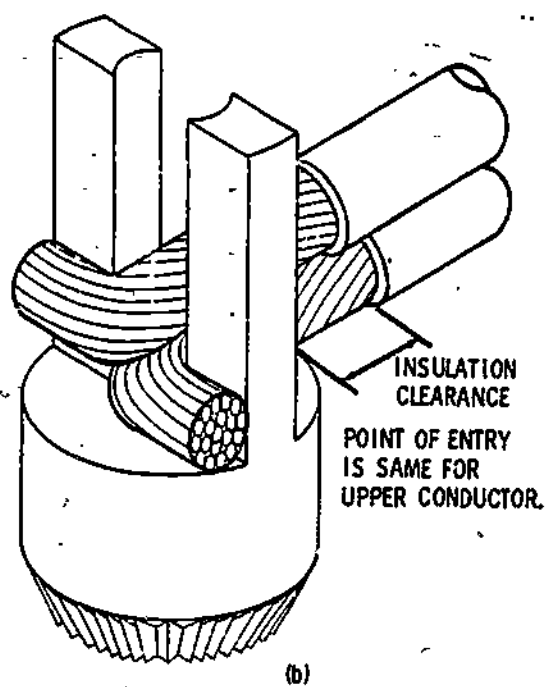
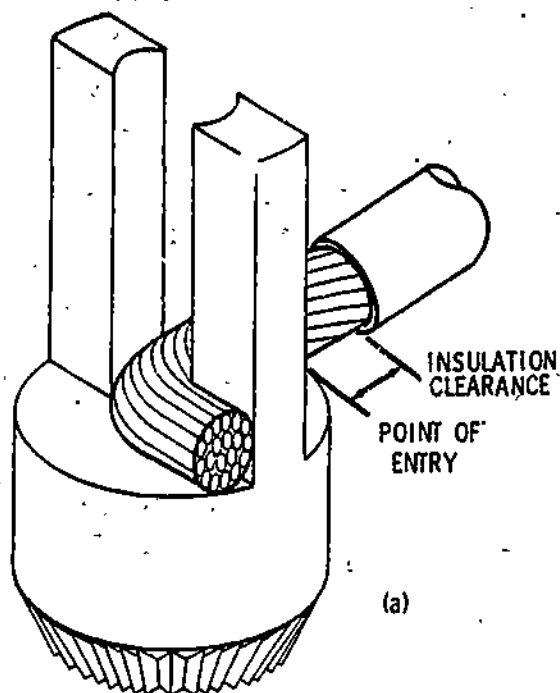


FIGURE 6-3--SIDE ROUTE CONNECTION TO BIFURCATED TERMINAL

1575



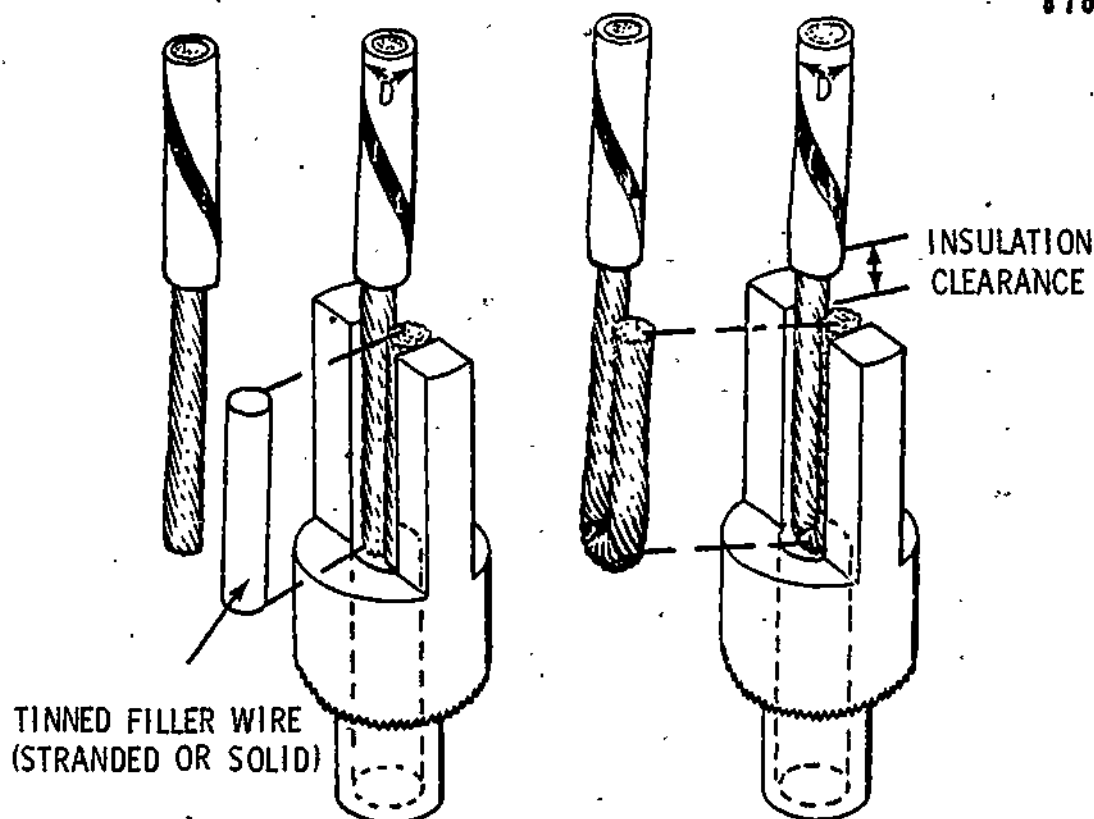


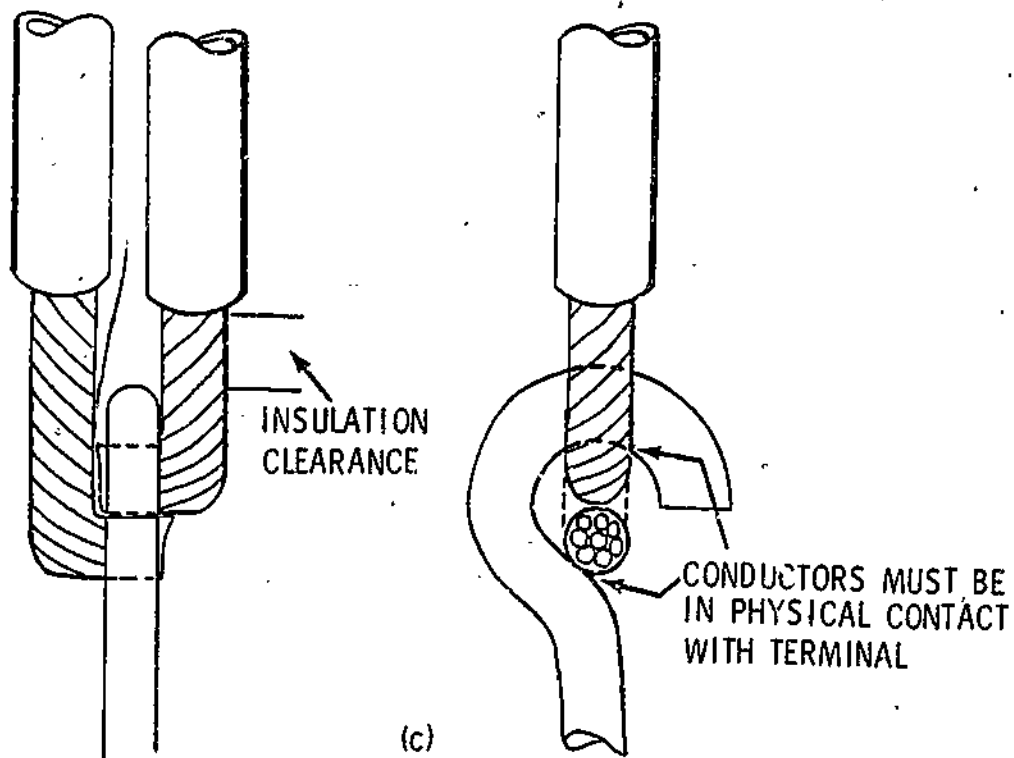
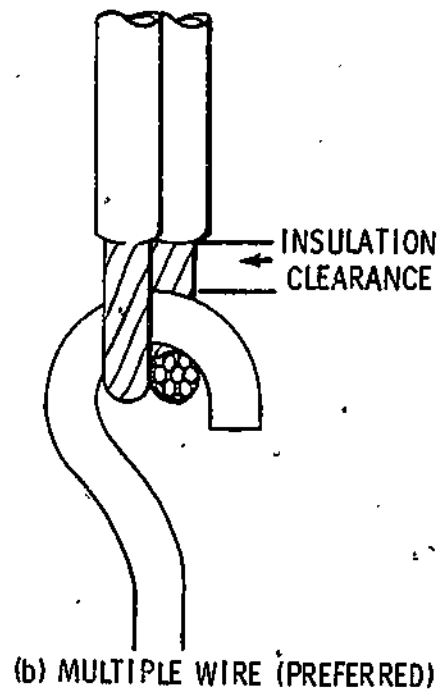
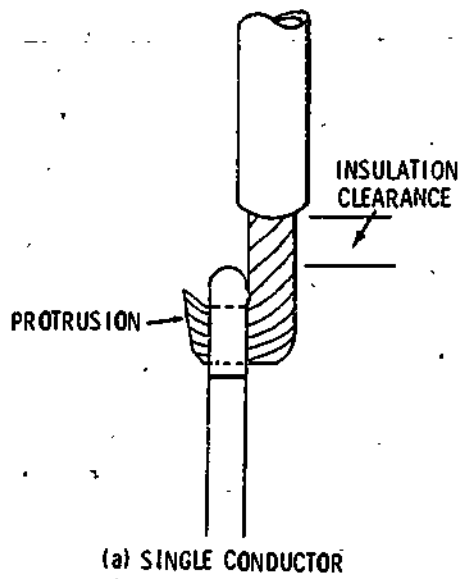
FIGURE 6-4..TOP ROUTE CONNECTION TO BIFURCATED TERMINAL

- ✓ bent double as shown providing the combined diameters are sufficient to fill the gap. The top route and side route shall not be used on the same terminal. The top route shall not be used if there is sufficient room for side entry.
5. TOP AND BOTTOM ROUTE. The bottom route shall be installed first as shown in Figure 6-2, then the top route as shown in Figure 6-4 with the top route conductor bottoming on the bottom route conductor.
  6. SIDE AND BOTTOM ROUTE. The bottom route shall be installed first as shown in Figure 6-2, then the side route as shown in Figure 6-3.

### 3A604 HOOK TERMINALS

Connections to hook terminals shall be as shown in Figure 6-5. The bend to attach conductors to hook terminals shall be a minimum of  $1/4$  turn to a maximum of  $3/4$  turn. Protrusion of conductor





MULTIPLE CONDUCTOR,  
PERMISSABLE ONLY WHERE  
REQUIRED BY SPACE LIMITATIONS

FIGURE 6-5--CONNECTIONS TO HOOK TERMINAL

ends shall be limited to avoid damage to insulation sleeving where used.

#### 3A605 PIERCED TERMINALS

Connections to pierced terminals shall be as shown in Figure 6-6. The bend to attach conductors to pierced terminals shall be a minimum of  $1/4$  to a maximum of  $3/4$  turn. Protrusion of conductor ends shall be limited to avoid damage to insulation sleeving where used.

#### 3A606 SOLDER CUPS (CONNECTOR TYPE)

Conductors shall enter the solder cup as shown in Figure 6-7. Conductors shall be bottomed in the cup and shall be in contact with the inner wall of the cup. The maximum number of conductors shall be limited to those which can be in contact with the full height of the inner wall of the cup.

#### 3A607 SOLDER CUPS (SWAGED TYPE)

Connection shall be as shown in Figure 6-8. Conductors entering from the top shall be in contact with the inner wall of the cup and shall bottom in the cup or on the bottom conductor.

#### 3A608 CONNECTION WITHOUT TERMINALS

When solid conductors are approved by NASA to be used as straight pin type terminals, conductors shall be terminated as specified in paragraph 3A602.

#### 3A609 LAP JOINTS

A lap joint may be used for attaching conductors only where space does not allow room for bending the conductor, and the application has been reviewed by the procuring NASA Installation.

#### 3A610 INSULATION TUBING APPLICATION

Insulation tubing shall be used for electrical insulation, as appropriate; for example, hook terminals and solder cups which are not protected by insulating grommets, potting or conformal coating.

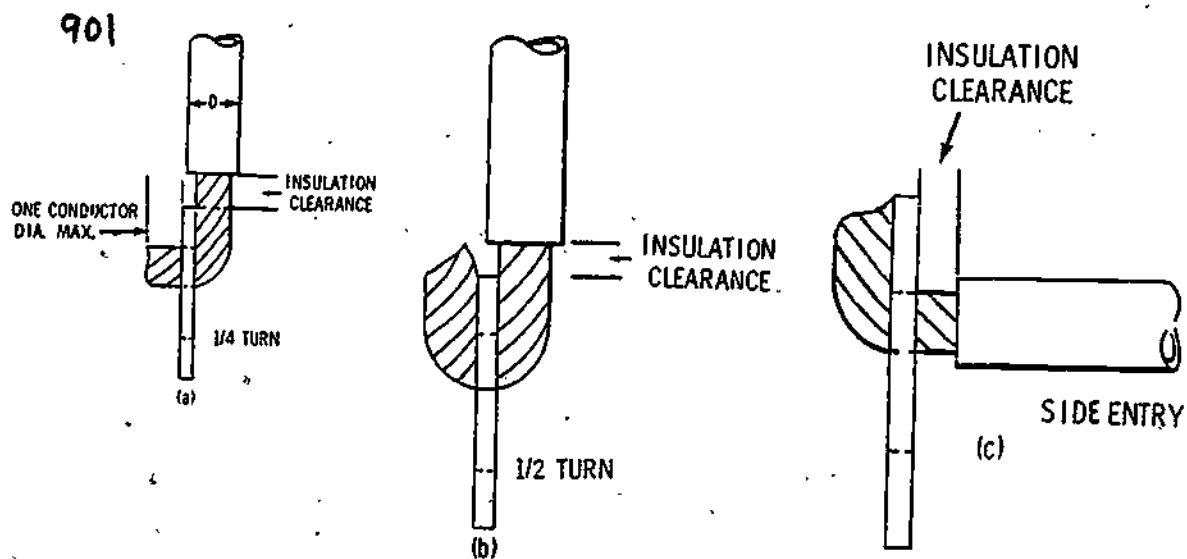


FIGURE 6-6--CONNECTIONS TO PIERCED TERMINALS

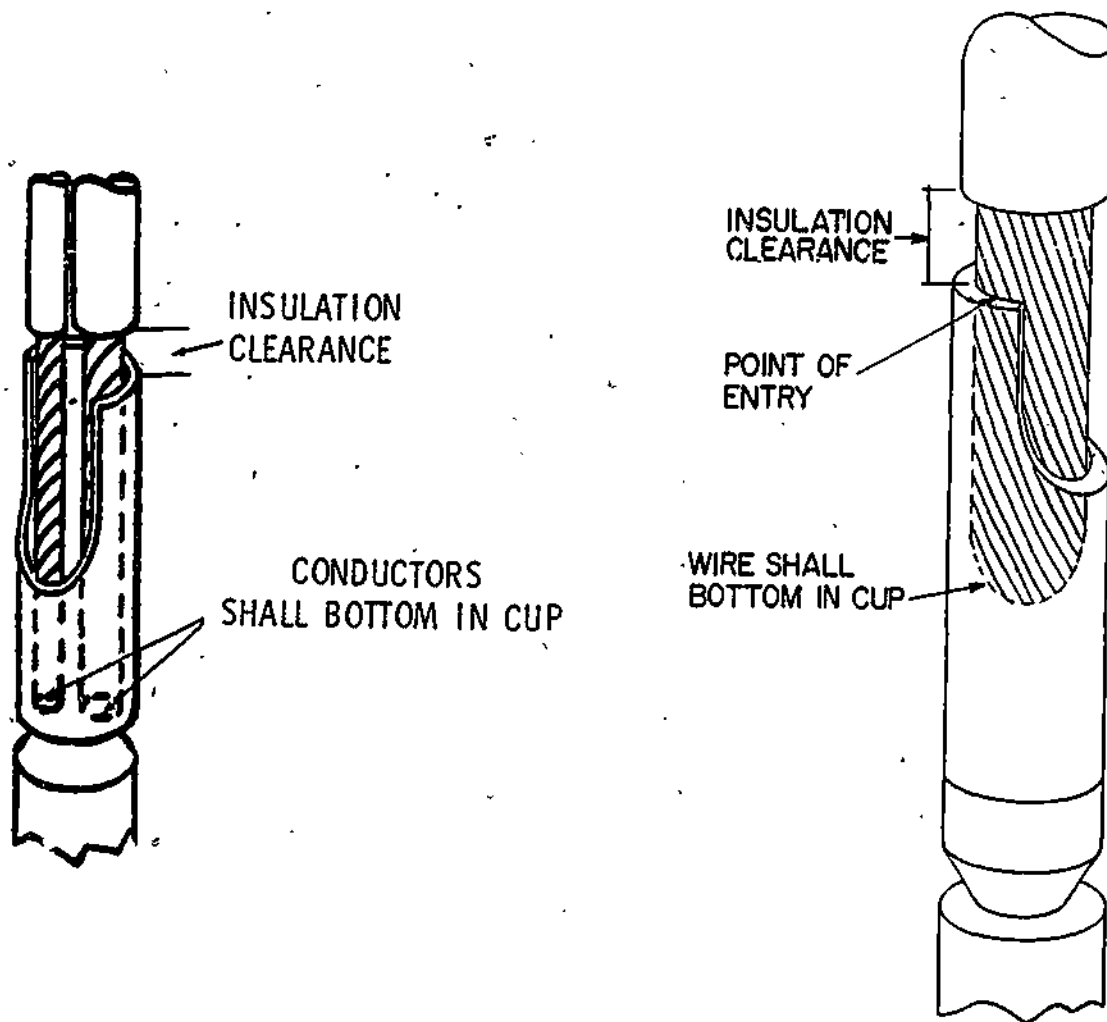
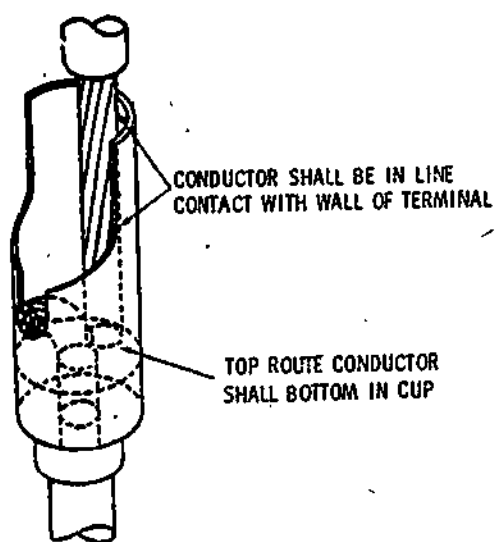
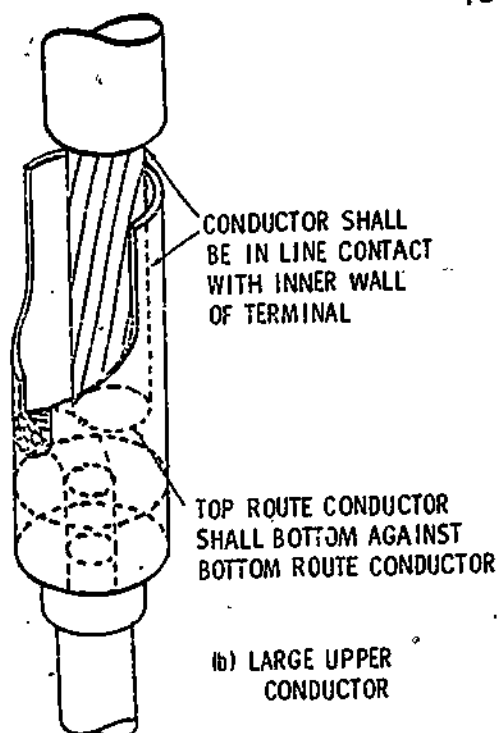


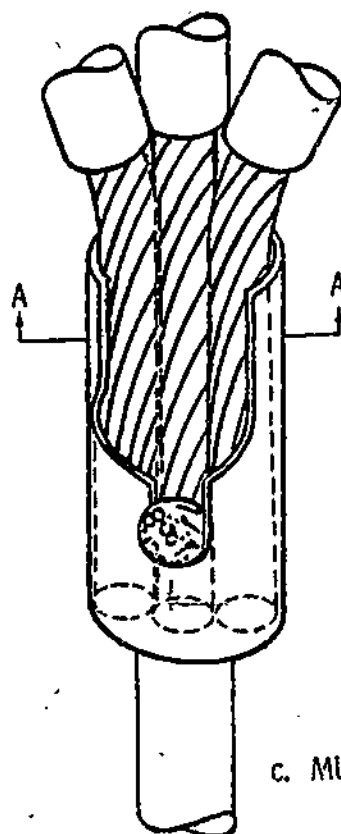
FIGURE 6-7--CONNECTIONS TO SOLDER CUPS (CONNECTOR TYPE)



(a) SMALL UPPER CONDUCTOR



(b) LARGE UPPER CONDUCTOR



C. MULTIPLE WIRES IN TOP ROUTE

FIGURE 6-8--CONNECTIONS TO SWAGED TYPE SOLDER CUPS

## CHAPTER 7: SOLDERING OF TERMINALS

### 3A700 GENERAL

1. SECURING CONDUCTORS. There shall be no relative motion between conductors and the terminal during soldering and while the solder is solidifying.
2. INSULATION SLEEVING, POTTING OR COATING. Protective coverings or coatings on the soldered terminals shall comply with requirements of the contract or purchase order.

### 3A701 SOLDER APPLICATION

1. SWAGED TERMINALS. Terminals swaged to a solid flat conductor shall be soldered to one surface of the conductor.
2. ALL TERMINALS EXCEPT CUP
  - a. A concave fillet of solder shall be formed between the terminal and each side of the conductor.
  - b. The contour of the conductor shall be visible after soldering.
  - c. Terminals with more than one wire shall have each wire in contact with and soldered to the terminal.
3. CUP TERMINALS
  - a. The solder shall form a fillet between the conductor and the cup entry slot. The fillet shall follow the contour of the cup opening within the limits illustrated in the satisfactory solder connections, Appendix B.
  - b. Solder spillage along the outside surface of the solder cup is permissible to the extent that it approximates tinning and does not interfere with the assembly or function of the connector.
4. WICKING. Flow of solder along the wire is permitted. Solder shall not obscure the contour of the conductor at the termination of the insulation.

### 3A702 REMOVAL OF FLUX AND RESIDUE

After the solder has solidified and cooled, flux and residue shall be carefully removed from each solder connection using a solvent as specified in paragraph 3A311.

### 3A703 INSPECTION

Each soldered connection shall be visually inspected in accordance with the criteria of this chapter. Magnification shall be as specified by the procuring NASA Installation. Parts and conductors shall not be physically disturbed to aid inspection. Illustrations of typical satisfactory and unsatisfactory soldered connections are shown in Appendix B.

### 3A704 ACCEPTANCE CRITERIA

An acceptable solder connection will be characterized by:

1. Clean, smooth, undisturbed surface.
2. Concave fillet between conductor and termination.
3. Contour of conductor visible.
4. Complete wetting.

### 3A705 REJECTION CRITERIA

The following are some characteristics of unsatisfactory solder conditions which are cause for rejection:

1. CONDUCTORS AND PARTS:
  - a. Damaged, crushed, cracked, charred, melted, etc.
  - b. Improper insulation clearance.
  - c. Improper tinning.
  - d. Separation of wire strands.
  - e. Part improperly supported or positioned.
  - f. Part marking not visible.
  - g. Part damaged.
  - h. Loose conductors.
  - i. Cut, nicked, stretched or scraped leads or wires.
  - j. Flux residue or other contamination.
  - k. Improper wrap or stress relief.

2. SOLDER CONNECTIONS:

- a. Cold joint.
- b. Overheated joint.
- c. Fractured joint.
- d. Bare copper or base metal.
- e. Improperly bonded joint.
- f. Pitted or porous joint.
- g. Excessive solder.
- h. Insufficient solder.
- i. Splattering of flux or solder or adjacent areas.
- j. Rosin solder connection.
- k. Unclean connection (e.g., lint, flux, dirt, etc.).
- l. Dewetting.

1583

## CHAPTER 8: PRINTED WIRING ASSEMBLY SOLDERING

### 3A800 FABRICATION AND CONFORMAL COATING

Printed wiring boards shall be designed, fabricated, and inspected in accordance with the requirements of the contract or purchase order. The assembly of parts, soldering and inspection of the completed wiring assemblies shall be in accordance with the requirements herein.

### 3A801 GENERAL REQUIREMENTS

1. DIP SOLDERING. Manual dip soldering of printed wiring assemblies is not permitted.
2. PATTERN REPAIR. Repair of damaged or broken conductor patterns on printed wiring boards is not permitted.
3. MACHINE SOLDER REWORK. Rework of machine soldered printed wiring assemblies shall be performed in accordance with the soldering requirements of this publication.
4. GOLD REMOVAL. Gold plating shall be removed from the printed board areas to be soldered prior to mounting of parts. Removal shall not damage the copper conductor or add permanent contaminants to the insulating board. Boards shall be cleaned of contaminants before further processing.
5. EYELETS, TUBELETS AND PLATED-THROUGH HOLES. Eyelets or tubelets shall not be used as part of the electrical circuit on printed wiring boards. Plated-through holes shall not be used unaided as the electrical connection between conductor patterns on double-sided boards. A solid copper conductor, or a part lead, shall be used to make the interfacial electrical connection.

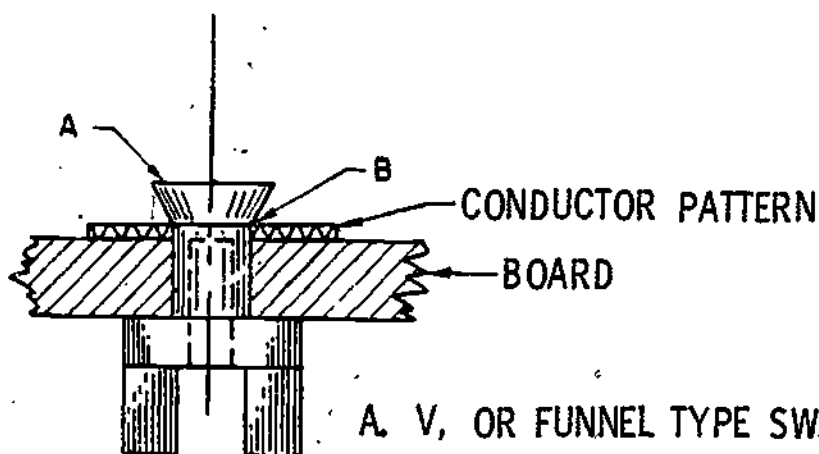
### 3A802 PRINTED WIRING BOARD PROTECTION

Printed wiring boards shall be protected to prevent damage or contamination during fabrication, inspection, in-plant transportation, and interim storage.

### 3A803 TERMINAL SOLDERING

Terminals swaged to conductor patterns shall be funnel swaged ("V" swaged) and soldered at all points of contact between the terminal and the conductor pattern. Roll type swaging shall not be used on the conductor pattern (see Figure 8-1). Terminals shall not be used for interfacial connection.





A. V, OR FUNNEL TYPE SWAGE.

B. POINT TO APPLY SOLDER IF  
SOLDER RING IS NOT USED.

FIGURE 8-1--TYPICAL SWAGED TERMINAL ON PRINTED WIRING BOARD

### 3A804 PREPARATION AND SOLDERING OF TERMINATION AREAS

1. TERMINATION AREA. The termination area shall be clean prior to soldering. Soldering to printed wiring termination areas shall be to the base metal or to tin-lead coated base metal.
2. SOLDERING TO TERMINATION AREAS. The melted solder shall flow around the conductor and over the termination area so that a fillet is formed. The outline of the lead shall be visible in the finished connection. After soldering, flux residue and other contaminants shall be removed.

### 3A805 INSPECTION

Each completed printed wiring assembly shall be visually inspected to the criteria listed in paragraphs 3A806 and 3A807 and for other indications of poor workmanship or nonconformance to the design drawings. Magnification shall be as specified by the procuring NAS/Installation.

### 3A806 ACCEPTANCE CRITERIA

The following are characteristics of acceptable solder connection to printed wiring assemblies:

1. Clean, smooth, undisturbed surface.
2. Regular, even fillet between conductor and termination area.
3. Contour of conductor visible.
4. Complete wetting.

The following are some characteristics of unsatisfactory printed wiring assemblies which are cause for rejection:

1. Charred, burned, or melted insulation or parts.
2. Conductor pattern separation from board.
3. Burns on base materials.
4. Discoloration which is continuous between conductors (e.g., measling, delamination, halo effect, etc.)
5. Excessive solder (including peaks, icicles, and bridging).
6. Flux residue, solder splatter, or other foreign matter.
7. Dewetting.
8. Insufficient solder (a small amount of exposed base metal around the periphery of the termination area or at the end of a conductor is acceptable if conformal coating will be applied).
9. Pits, holes or voids, or exposed base metal in the soldered connection.
10. Cold, rosin, disturbed, or fractured solder connection.
11. Cut, nicked, gouged, or scraped conductors or conductor pattern.
12. Improper conductor length or direction of clinch.
13. Repaired or damaged conductor pattern.

## CHAPTER 9: AUTOMATIC MACHINE SOLDERING

### 3A900 GENERAL

This chapter contains requirements peculiar to automatic machine soldering. General requirements including acceptance and rejection criteria specified in this publication are applicable.

### 3A901 DOCUMENTATION

1. The supplier shall establish complete and detailed documentation for operation and maintenance of the soldering machines and their environment, and for inspection of both the process and the end-products.
2. The documentation shall set limits on the:
  - a. Preheat temperature,
  - b. Temperature of the solder,
  - c. Conveyor speed,
  - d. Height of the solder wave,
  - e. Control of the dross inhibition oil and flux (if fluxing is done as a machine step),
  - f. Amount of contaminants permissible when the solder bath is analyzed,
  - g. Frequency of maintenance and of analysis and other factors affecting the quality of the connections in the end-product,

Maintenance and calibration data shall be recorded and available to Government and supplier inspection.

### 3A902 PREPARATION AND ASSEMBLY

1. Only tin-lead (solder) coated and reflowed electro-plated tin-lead coated conductor patterns shall be used in machine soldering of printed wiring board assemblies.
2. Parts shall be mounted as specified in Chapters 5 and 6 of this document. The mounting shall prevent relative motion between part and board during solder solidification.
3. The assembled boards shall be clean immediately prior to loading on to the carrier.

4. Metal surfaces not to be soldered shall be masked or coated with a solder resist prior to loading.
5. Liquid flux specified in paragraph 3A310 shall be applied.

### 3A903 MACHINE REQUIREMENTS

1. The preheat temperature shall be controlled to a selected temperature between 160° and 180° F. The selected temperature shall be maintained within  $\pm 5^\circ$  F.
2. The conveyer speed shall be controlled to a preselected speed, which shall not vary more than 1 inch per minute.
3. Solder temperature shall be controlled so that the solder in the wave making contact with the board is 490° F  $\pm 10^\circ$  F.
4. The oil used as a dross inhibitor shall have a flash point higher than the maximum solder temperature.
5. The height of the solder wave shall be controlled to a constant preselected height.
6. The solder bath shall be chemically analyzed periodically for conformance with the requirements of paragraph 3A309 except that copper content shall not exceed 0.2%.

### 3A904 CLEANING

After soldering, flux and dross inhibitor oil shall be promptly removed in a manner which does not damage the hardware.

### 3A905 INSPECTION

Inspection criteria listed in Chapter 8 are applicable to machine soldered assemblies. Warp or twist of the board shall not exceed the limits specified by the detail drawing.

## DEFINITIONS

The following definitions apply to terms used in this Handbook.

Article. A unit of hardware or any portion thereof required by the contract.

Bifurcated (split) Terminal. A terminal containing a slot or split in which wires or leads are placed before soldering.

Certification. The act of competent authority in verifying and documenting that personnel have completed required training and have demonstrated specified proficiency and have met other specified requirements.

Cold Solder Connection. Unsatisfactory connection resulting from dewetting and exhibiting an abrupt rise of the solder from the surface being soldered.

Conduction Soldering. Method of soldering which employs a soldering iron for transfer of heat to the soldering area.

Conductor. A lead or wire, solid or stranded, serving as an electrical connection between terminals.

Conformal Coating. A thin protective coating which conforms to the configuration of the covered assembly.

Corridor Construction. Circuitry in which parts are mounted between, and perpendicular to, two printed wiring or conductive networks.

Deviation. A specific authorization, granted before the fact, to depart from a particular requirement of specifications or related documents.

Dewetting. The condition in a soldered area in which the liquid solder has not adhered intimately, characterized by an abrupt boundary between solder and conductor, or solder and terminal/termination area.

Disturbed Solder Connection. Unsatisfactory connection resulting from relative motion between the conductor and termination during solidification of the solder.

Electrical Connection. Connections in electrical or electronic circuits.

9/2

Excessive Solder Connection. Unsatisfactory connection wherein the solder obscures the configuration of the connection.

Eyelet. A tubular metal part having both ends headed or rolled over.

Fractured Joint. A solder joint in which the solder has fractured or broken between the joint elements.

Hook Terminal. A terminal formed in a hook shape.

Mission Essential Support Equipment. Mission-essential support equipment is defined as satisfying any of the following:

1. Equipment used in a closed loop with the system where failure would degrade the mission or imperil personnel.
2. Equipment used when transferring toxic or explosive fluids, in which failure could result in personnel hazards or affect mission success.
3. Equipment used as a last check prior to installation whose failure would result in lowering the probability of mission success or compromising personnel safety.

Part Lead. The wire, solid or stranded, which extends from and serves as a connection to a part.

Part. One piece, or two or more pieces joined together which are not normally subject to disassembly without destruction of designed use. Synonymous with detail part and component part (e.g. resistor, capacitor, valve, relay).

Potting Compound. A nonconductive compound used for encapsulation of parts, conductors or assemblies.

Pierced (Perforated) Terminal. A terminal containing a hole through which leads or wires are placed before soldering.

Pits. Small holes or sharp depressions in the surface of the solder.

Repair. Operations performed on a nonconforming article to place it in useable and acceptable condition. Repair is distinguished from rework.

Resistance Soldering. Method of soldering, by passing a current between two electrodes through the area to be soldered.

Rework. The reprocessing of articles or material that will make it conform to drawings, specification or contract.

Rosin Solder Connection. Unsatisfactory connection which has trapped flux.

Overheated Joint. An unsatisfactory solder joint, characterized by rough solder surface.

Solder. A nonferrous, fusible metallic alloy used when melted to join metallic surfaces.

Solder Cup Terminal. A hollow, cylindrical terminal to accommodate one or more conductors.

Soldering. The process of joining metallic surfaces through the use of solder without direct fusion of the base metals.

Straight Pin Terminal. A round post-type smooth terminal, with no grooves, slots, or guides.

Supplier. A contractor or subcontractor actually performing the services or producing the contract articles.

Terminal. A tie point device used for making electrical connections.

Termination. The point at which an electrical conductor ends, usually at an electrical connection.

Termination Area. A conductive surface on a printed wiring board used for making electrical connections. (Also referred to as printed circuit pad).

Thermal Shunt. A device with good heat dissipation characteristics used to conduct heat away from an article being soldered.

Tinning. The coating of a surface with a uniform layer of solder, before it is used in a soldered connection.

Tubelet. A tubular metal part with both ends formed in a conical flare of approximately 90 degrees included angle.

Turret Terminal. A round post-type grooved stud around which conductors are fastened before soldering.

Waiver. Granted use, or acceptance, of an article which does not meet specified requirements.

Wetting. Adhesion of a liquid to a solid surface.

Wicking. The flow of molten solder by capillary action.

## APPENDIX B

**TYPICAL SATISFACTORY AND UNSATISFACTORY  
SOLDER CONNECTIONS**

The Illustrations in this Appendix depict typical satisfactory and unsatisfactory solder connections and are to be used as visual workmanship standards. See paragraphs 3A703, 3A805 and 3A905.

b-1



FIGURE 8-1--SOLDERED TURRET TERMINALS

Unacceptable  
Insufficient  
SolderAcceptable  
Minimum SolderPREFERRED  
SOLDERAcceptable  
Maximum SolderUnacceptable  
Excessive Solder

1594

1593

Laboratory Group on all measures. Demographic data for both Test 1 and Test 2 participants showed the reference groups to be significantly older, to have higher class standing, more educational training and professional education, and to have higher grade point averages than the Laboratory Group. Furthermore, Reference Group B was higher than Reference Group A on these factors. The researcher observed that for the Laboratory Group, the data showed a net performance gain. The final performance of this group was not appreciably different from Reference Group A which had participants with a much larger amount of occupational experience. Reference Group B was generally superior to the other two groups on a variety of measures. Egglund pointed out that the results indicate that certain professional competencies traditionally developed through occupational experience may be developed by other means. Specifically, a directed occupational experience appeared to be an alternative that does indeed develop professional competence. Two additional implications written by Egglund were that this study demonstrated the possibility for the alternative development of professional competencies, and that gains made by the laboratory group showed that the modules were a viable instructional strategy to serve as a catalyst to an alternative competency development strategy.

In a study which reported perhaps surprising results, Olsen (1971) randomly surveyed twenty-five coordinators and 125 training sponsors to determine whether differences existed between teachers with various occupational backgrounds in relation to student competencies, number of students remaining in distributive occupations, and program success in preparing individuals for employment in retailing. Although the research reported that significant findings were questionable because of the small number of cases involved, he concluded that the study tended to indicate that coordinators should have nonsupervisory occupational experience, no distributive experience in the four years prior to the data collection, and should make regular training station visits.

#### Inservice Teacher Education Studies

Four studies were located which dealt with the identification of professional development needs of teacher coordinators which gave insight concerning inservice teacher education needs. Kohns (1975) identified and analyzed common and unique professional development needs of beginning and experienced high school and postsecondary distributive education personnel in Minnesota. He also compared these needs based upon whether or not the personnel had a collegiate distributive education major. In a similar study, Kirkley (1977) determined professional development competency needs of teacher coordinators in South Carolina.

FIGURE 8-1--SOLDERED TURRET TERMINALS--Con.



PREFERRED SOLDER



Unacceptable  
Insufficient  
Solder



Acceptable  
Minimum  
Solder



Acceptable  
Maximum  
Solder



Unacceptable  
Excessive  
Solder

15958

1596

9/6

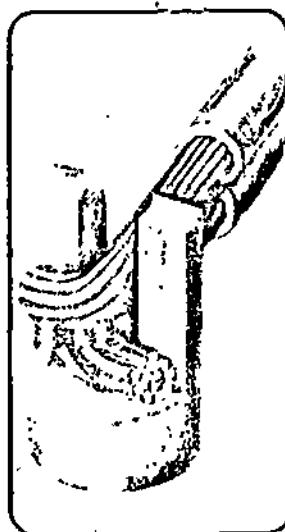
Berns (1979) synthesized the Crawford (1967) critical tasks and surveyed graduates of the teacher education program at Virginia Polytechnic Institute and State University and their assistant state supervisors, local supervisors, vocational directors, and principals to determine the level of proficiency at which these graduates were performing the synthesized tasks. He also identified the value placed on the required and elective courses in the distributive teacher education curriculum by the graduates as well as their perceptions of the value of the supporting services rendered by the program. In addition, the short-term and long-range career aspirations of the graduates and graduate courses and experiences required to achieve these career objectives were identified. He found that the graduates were generally performing well according to each of the respondent groups and no courses were identified as being of no value to the graduate.

The Crawford (1967) and Cotrell (1971) studies served as the basis for an investigation of the attitudes of distributive education teacher coordinators toward their preparation to perform tasks in ten functional areas. This study, conducted by Heath-Sipos (1979), found that teacher coordinators perceived themselves as adequately prepared in instructional planning, instructional evaluation, guidance, and technical knowledge, but not quite adequately prepared in program planning, instructional execution, instructional management, school and community relations, student vocational organization, coordination, and professional role and development. She also found that a relationship existed between attitudes of teachers toward their preparation and their attitudes toward their advisors, and that males had more positive attitudes than females. The population of this survey was 1976-77 teacher education graduates from thirteen central states who were certified to teach distributive education and had at least one year of teaching experience.

Walette (1974) completed a status study of distributive teacher education programs by surveying teacher educators and state supervisors. He found that the number of distributive education courses offered ranged from two to twenty-one. Distributive education departments at small institutions typically identified with the school of business whereas distributive education departments at large institutions usually identified with the school of education. He also found that approximately 80 percent of the graduates of the programs studied were placed in distributive education positions.

One study was located which dealt with graduate distributive education. Cooley (1975) conducted a twenty-year follow-up study to appraise the masters program in distributive education at Northwestern State University of Louisiana. This mail survey

FIGURE B-2--SOLDERED BIFURCATED TERMINALS

Unacceptable  
Insufficient  
SolderAcceptable  
Minimum  
SolderPREFERRED  
SOLDERAcceptable  
Maximum  
SolderUnacceptable  
Excessive  
Solder

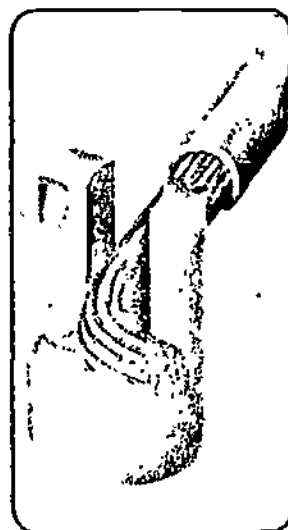
## ADMINISTRATION AND SUPERVISION

Very little research was found which specifically addressed the topic of administration or supervision. Of course, many of the studies reviewed in the program evaluation section of this book relate to administration, as do studies throughout other sections. Furthermore, much research with application to marketing and distributive education may be found in the area of vocational education administration and general educational administration. This research falls outside the parameters set for this review and synthesis, since only those studies related directly to marketing and distributive education are reported here.

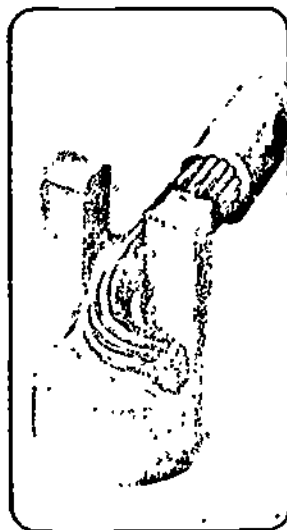
Crawford (1975) surveyed teacher educators and state supervisors throughout the country and identified basic beliefs concerning administration. Two examples of these beliefs were that distributive education should be an integral part of the public school system, and a state supervisory service in distributive education should be maintained in order to assist and advise local communities to expand and develop programs responsive to employment trends and to the needs of target populations.

Biddle (1972) and Devitt (1978) surveyed state supervisors to compile data related to state supervision in distributive education. Devitt's study compared the 1978 findings with Biddle's 1972 findings to attempt to identify trends in state supervision. Among the trends she found were a trend away from utilizing "supervisor" in the title of the head state level distributive

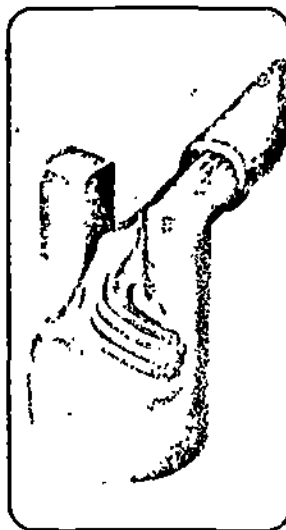
FIGURE 8-2--SOLDERED BIFURCATED TERMINALS--Con.



Unacceptable  
Insufficient  
Solder



Acceptable  
Minimum  
Solder



PREFERRED  
SOLDER



Acceptable  
Maximum  
Solder



Unacceptable  
Excessive  
Solder

1599

b-5

1600

9/8

programs, teacher coordinator updating in the field of  
marketing, employer training, and community feedback.



## EVALUATION

The decade of the 70s has brought an increase in emphasis on vocational program evaluation. A trend was seen toward more sophistication in the kinds of evaluative studies and toward consideration of a wider array of evaluative outcomes. These trends are evident in the number and variety of marketing and distributive education program evaluation studies appearing in the literature.

This review of evaluation research includes three general kinds of research questions. They are: (1) Are the programs valid, effective, and/or efficient as indicated by some measure of student achievement; (2) Are the programs valid, effective, and/or efficient as indicated by the value judgments of people who are "expert" or qualified to judge; (3) Do the programs project a favorable "image"? The first two kinds of questions were answered with studies that compared program characteristics or outcomes with evaluative criteria. The third type of investigation simply described the program and left evaluation to the reader or to another subsequent investigation.

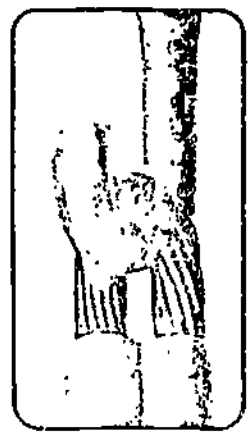
### Studies Involving Measurements of Student Success

The ideal evaluation of any vocational program should include consideration of how well the intended objectives are achieved. Success is typically thought of as indicated by performance in the

FIGURE B-3--SOLDERED HOOK TERMINALS



Unacceptable  
Insufficient  
Solder



Acceptable  
Minimum  
Solder



PREFERRED  
SOLDER



Acceptable  
Maximum  
Solder



Unacceptable  
Maximum  
Solder

1602

1601

Consistent with the findings of Murphy (described above), Wilkinson found that students did not perform on the job any better than the nonDE coworkers. The nonDE group were just as satisfied in their jobs, they expressed basically the same job aspirations, and they performed the same functions at the same levels of responsibility as the DE group. Some of the positive findings were: DE graduates found employment faster; they exhibited more job stability; they obtained higher beginning wages; and they received more salary increases during the first fifteen months of employment.

Wilkinson reported that the Iowa DE students on the average obtained a 2.0 grade point average during 11th and 12th grades. In some areas, if not in Iowa, it may be that the DE student population is somewhat less capable than the general population of workers. Therefore, if they perform as well in employment, it might be inferred that the DE program was successful in that it might have contributed to overcoming a disadvantage endemic to the DE student population. Research on this question might provide an explanation for what appears to be a weakness in DE programs in the area of technical skill development.

A similar investigation was conducted by Wilkinson and Miles (1977). Again, a representative sample was drawn. However, the data source was DE training sponsors, and mail questionnaires were used. The training sponsors were asked to compare DE students with regular part-time high school students. Findings regarding specific job skills were similar to what Wilkinson found. The DE students were not better than their untrained counterparts.

With respect to some of the more subtle kinds of learning outcomes that are emphasized in DE, and which are rarely evaluated, the Florida coordinators appeared to be doing an excellent job. The employers evaluated the DE students as having better attitudes than nonDE student employees. On this factor the chi square value was large enough to be significant at the .0007 level. On such factors as dependability, loyalty, ability to accept criticism, and the like, the employers rated DE students much higher. Also, the employers gave very high marks to the DE coordinators for their contribution to the education and training of the students.

Harris and White (1975) conducted a follow-up study in Indiana to investigate employer perceptions, student backgrounds, coordinator backgrounds, employers characteristics, program characteristics, and postprogram student activities. In that study, a sample of 1,032 students from ten small cities were asked to respond to a questionnaire. The DE group included eighty-one respondents. The variables which should be of interest to distributive educators were graduates' personal characteristics, their employment status, and

1694

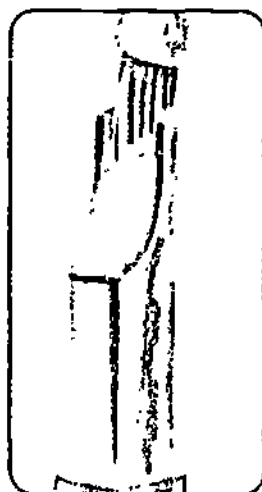
920

1693

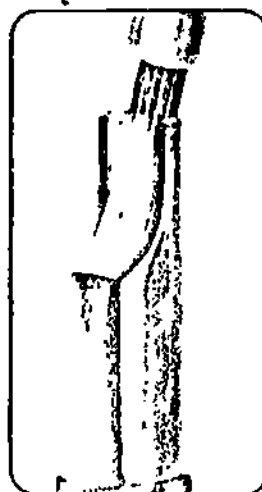
b-8



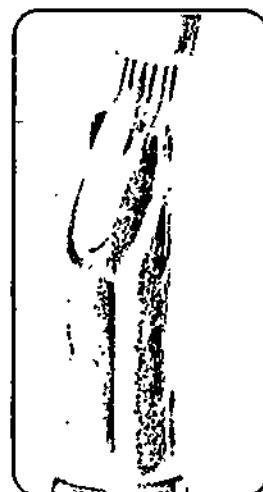
Unacceptable  
Insufficient  
Solder



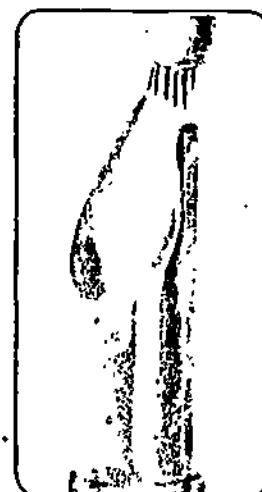
Acceptable  
Minimum  
Solder



PREFERRED  
SOLDER



Acceptable  
Maximum  
Solder



Unacceptable  
Excessive  
Solder

FIGURE B-4--SOLDERED CUP TERMINALS

Palmieri (1973) studied the relationship between distributive education preparation and post high school success. Ninety-seven distributive education graduates (selected from a population of 457 who had been enrolled in the twenty-two Detroit public high schools) were interviewed three years after graduation. It was found that many DE students were not being hired in distributive occupations. They were mainly securing employment in clerical occupations. This was found to be true even though sales jobs were apparently available for the graduates. Apparently few specialized job skills were demanded by employers of DE graduates and they were not likely to be promoted. It is interesting to note that in this study of Distributive Education in a large metropolitan area, the outcomes were more negative than in the previous study where small city DE graduates were the focus of the research.

#### Distributive Education Students Versus College Preparatory Students

Faehnle (1976) conducted an investigation to ascertain what, if any, the differences were in academic achievement in undergraduate college marketing programs between students with DE and those with college preparatory backgrounds in high school. Eighty marketing majors from universities in northwest Ohio were used to provide data on the relationship of high school background and college attendance to four areas of the marketing major's academic achievement. The distributive education students and their college preparatory student counterparts did equally well in overall academic achievement, college marketing program achievement, and marketing-related course achievement. It was concluded that it did not matter whether a high school student pursued a DE or college preparatory course of studies, since the results of this study showed no significant difference in academic achievement in college. Neither high school curricular background necessarily aided or hindered students in the further formal study of marketing.

#### Attitudes of Students and Teachers

Several evaluative studies have been completed that measure attitudes toward business and marketing. Two studies were completed by Karp and Sears Merchandising Research (1974, 1975) for the National Management Advisory Council. In the first, the attitudes of DE and nonDE students toward specific business concepts were compared. In addition to a great deal of information on specific knowledge and attitudes of students, the overall conclusion of the study was that DE students were no more positive toward business than nonDE students, and in general, were less positive than had been expected.

FIGURE B-3--SOLDERED HOOK TERMINALS-Cont.



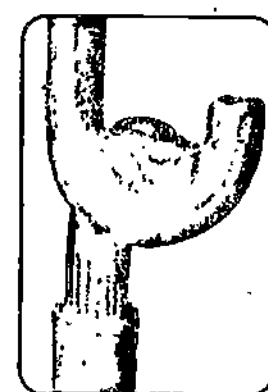
Unacceptable  
Insufficient  
Solder



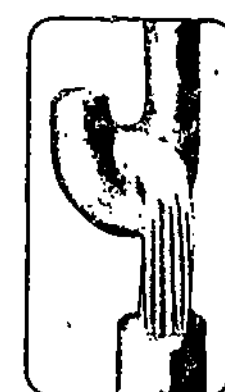
Acceptable  
Minimum  
Solder



PREFERRED  
SOLDER



PREFERRED  
SOLDER



Acceptable  
Maximum  
Solder



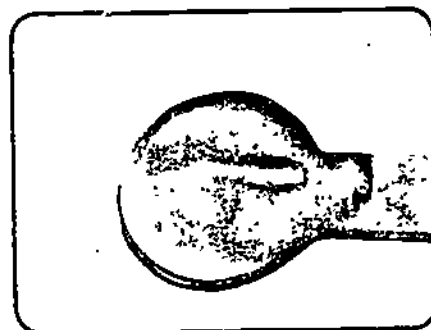
Unacceptable  
Excessive  
Solder

ERIC  
Full Text Provided by ERIC

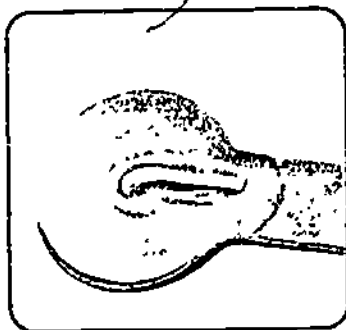
variables were participation in DECA, proximity of the program to a major city (apparently on the assumption that proximity provides access to training opportunities), specialization of the curriculum admission requirements, and type of school. Another set of variables which did not relate directly to program characteristics included sex of the student, relationship of the cooperative training experience to the student's occupational objective, and the student's expressed occupational objective. A variety of approaches were used in the analysis to determine if the program and student characteristics were related to whether or not the student entered the field for which training was provided in the program during the year following high school graduation. A two-state random sample procedure was used to select 364 graduates. Seventy-four percent responded to the questionnaire. Substantial relationships were found between entry into distributive occupations and two of the variables. Apparently when the student had an expressed occupational objective, and when the student actively participated in DECA, the student was likely to be employed in an occupation within the field of training. Therefore, it was concluded that students should be encouraged to participate in the DECA organization and it was also recommended that an effective selection and career development program should precede enrollment in distributive education.

Cushman (1973) conducted a similar investigation using data collected before and after graduation from 380 students who were enrolled in randomly selected secondary distributive education programs throughout New York state. The variables under study included age, sex, knowledge of subject matter, whether the student was enrolled in a cooperative program or not, the number of cooperative and noncooperative experiences, DECA membership, length of enrollment, amount of instruction, school store experience, and geographic location of the school. As in the previously described investigation, these variables were studied with respect to their relationship to entry into a related job or college curriculum. Nine of fifteen variables were found to correlate with the related employment or college enrollment criteria. Of those listed above, the related variables were age, sex, knowledge of subject matter, whether the student was enrolled in a cooperative program or not, DECA membership, length of enrollment, amount of instruction, school store experience, and geographic location of the school.

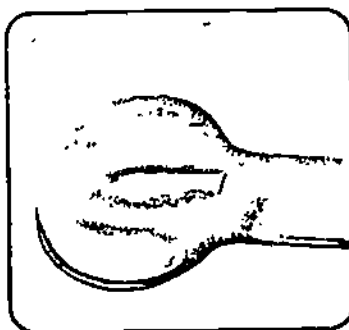
Another study in which a variety of program characteristics was related to placement status of graduates was completed by Hlebichuk (1971). In this study, the entire populations of eighteen teacher coordinators and 387 students in the state of Montana were used as the data source. Emphasis was on variables relating to teacher coordinator characteristics, the program, and student characteristics. In all, thirty-eight variables were



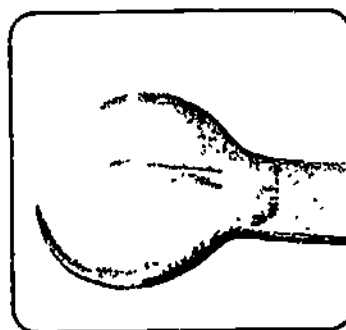
PREFERRED  
SOLDER



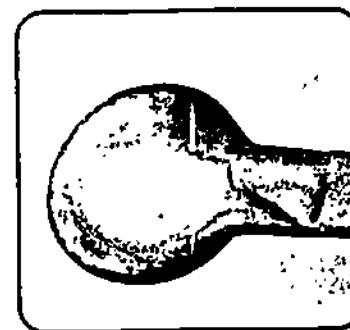
Unacceptable  
Insufficient  
Solder



Acceptable  
Minimum  
Solder



Acceptable  
Maximum  
Solder



Unacceptable  
Excessive  
Solder

FIGURE B-5--SOLDERED PRINTED WIRING AREAS

☆ U.S. GOVERNMENT PRINTING OFFICE: 1973-508-431/421

For sale by the Superintendent of Documents, U.S. Government Printing Office  
Washington, D.C. 20540 Price \$0.95

1697  
b-9

1698

922



coordination; effective coordinators tended to include window display and interior display as part of the subject matter taught.

Two generally related studies analyzed the effectiveness of the distributive education curriculum in developing selected knowledges and skills. Russell (1971) evaluated the sales knowledge and ability of three groups: DE salespeople, nonDE salespeople, and nonsalespeople in order to develop an instrument to measure sales ability. The test differentiated between salespeople and nonsalespeople, but no significant differences were found between those salespeople trained through DE and those not so trained.

Frunzi (1977) tested distributive education high school seniors in various phases of the DE program to determine their level of management understanding. Using the test "How to Supervise" published by the Psychological Corporation, he observed that the DE seniors tested scored significantly higher than the national norm.

#### ECONOMIC ANALYSIS OF DISTRIBUTIVE EDUCATION PROGRAMS

The studies reviewed in the preceding section were designed to determine whether or not distributive education (or some aspect of it) is successful as measured by student success of one kind or another. The following few studies also indicate student success but in a different way. These studies deal with the economic benefits to the individual and to society that result from participating in marketing and distributive education. The idea of evaluating vocational programs by comparing the economic costs with economic benefits derived from the program is not new. For the past two decades the literature contains a number of discourses advocating the use of cost-benefit analysis. Also, a number of very well written theoretical models for cost-benefit analysis have been developed. But in the field of distributive education few examples were found of cost-benefit analysis applied at the local level to evaluate specific programs. There were a few studies dealing with the economics of distributive education in a wider geographic area. None of the studies was designed to conform to the ideal model for cost-benefit analysis. This is mainly because the technology for implementing such a model simply does not exist. Ideally, cost-benefit analysis of a vocational program involves comparing the actual program costs with the discounted value of the benefits derived from program participation over the period of employment. Obviously the benefits that accrue over a lifetime of employment have to be calculated or estimated, and this is the weak link in the system.

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 2-1

PRINTED CIRCUIT BOARD COMPONENT INSTALLATION AND SOLDERING

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Install and solder a minimum of ten (10) various components on a selected single sided printed circuit board using preferred mounting styles and terminations with high reliability soldering techniques meeting or exceeding all specifications illustrated in MIL-S-45743E and described in Notetaking Sheet 2-1-1N.
8. Install and solder a minimum of six (6) various components on a selected double sided printed circuit board using any of the preferred mounting styles and terminations with high reliability soldering techniques meeting or exceeding all specifications illustrated in MIL-S-45743E and described in Notetaking Sheet 2-1-1N.

II. PERFORMANCE:

- A. Position a minimum of ten (10) instructor selected components, shape their leads and mount them on a single sided printed circuit board using the following styles and terminations, utilizing the high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 2-1-1N.
  1. Two (2) components with flush mounting and semi-clinch terminations.
  2. Two (2) components with flush mounting and straight thru terminations.
  3. Two (2) components with flush mounting and full clinch terminations.
  4. Two (2) components with stress relief mounting and straight thru terminations.
  5. Two (2) components with vertical mounting and straight thru terminations.

- B. Position a minimum of six (6) instructor selected components, shape their leads and mount them on a double sided printed circuit board using any of the preferred mounting styles, terminations and high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 2-1-1N.

NOTE: Circuit boards may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on component installation and soldering technique will be offered as information.

### III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in the completed boards with the minimum amount of components installed for grading by the seventh day of the course. Quality of completed work must meet the acceptable standards as illustrated in MIL-S-45743E and described in Notetaking Sheet 2-1-1N for a satisfactory (SAT) completion. If either or both of the boards are determined to be unsatisfactory (UNSAT), the student will be allowed to rework and resubmit them for grading, by the ninth day. Two UNSAT's on the same tasks will be cause for convening an academic board and possible drop from the course.

### IV. EQUIPMENT:

- A. One 2M kit
- B. One single sided printed circuit board
- C. One double sided printed circuit board
- D. A minimum of sixteen (16) component parts
- E. Consumable supplies as necessary.

1610

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 2-2

CONFORMAL COATING REMOVAL

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Identify the types of conformal coatings on printed circuit boards and determine the proper method of removal to be used for each coating, based on information contained in Volume 6 of PACE Rework and Repair Technology Series and Notetaking Sheet 2-2-IN.
- B. Remove various conformal coatings from printed circuit boards using the chemical, heat and abrasive methods of removal and the proper tools necessary as outlined in Volume 6 of the PACE Rework and Repair Technology Series and Notetaking Sheet 2-2-IN.

II. PERFORMANCE:

- A. Identify the conformal coating on a minimum of three instructor provided printed circuit boards, without error, and determine which method of removal is to be used. Identification and determination will be in concurrence with the information provided in Notetaking Sheet 2-2-IN and Information Sheet 2-2-II.
- B. Remove a minimum of one designated component from each coated printed circuit board using the chemical, heat and/or abrasive methods of removal as described in Volume 6 of the PACE Rework and Repair Technology Series and Notetaking Sheet 2-2-IN, with no damage or degradation to the components or printed circuit boards.

NOTE: Circuit boards used for Conformal Coating Removal may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on identification and coating removal will be offered as information.

### III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in the three circuit boards with the correct identification and specified components removed for grading by the seventh day of the course. Removal of coated components must be performed with no damage or degradation to the components or circuit boards to receive a satisfactory (SAT) grade. If the components removal is determined to be unsatisfactory (UNSAT), the student will be permitted to rework and resubmit them for grading, by the ninth day. Two UNSAT's on the same task will be cause for convening an academic board and possible drop from the course.

### IV. EQUIPMENT:

- A. One 2M kit
- B. Three selected printed circuit boards with a different type conformal coating on each
- C. Consumable supplies as necessary

1612

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 2-3

DESOLDERING PRINTED CIRCUIT BOARD COMPONENTS

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Identify the various types of solder connections by visual inspection of selected single and double sided printed circuit boards, evaluate the task to be performed and determine the proper desoldering and component removal method to be used. Identification, evaluation and determination will be based on information contained in Volume 6 of the PACE Rework and Repair Technology Series and Notetaking Sheet 2-3-1N.
- B. Remove components from selected printed circuit boards using the wicking, manual and motorized solder extraction methods of desoldering as described in Volume 6 of the PACE Rework and Repair Technology Series and Notetaking Sheet 2-3-1N, with minimum damage or degradation to the components and/or circuit boards.

II. PERFORMANCE:

- A. Remove a minimum of four (4) selected components from an instructor provided single sided printed circuit board using the wicking method of desoldering, in accordance with procedures and to the damage and degradation standards outlined in Volume 6 of the PACE Series and Notetaking Sheet 2-3-1N.
- B. Remove a minimum of four (4) selected components from an instructor provided double sided printed circuit board using the manual vacuum method of desoldering in accordance with the procedures and to the damage and degradation standards outlined in Volume 6 of the PACE Series and Notetaking Sheet 2-3-1N.
- C. Remove a minimum of four (4) selected components from an instructor provided double sided printed circuit board using the motorized extractor method of desoldering, in accordance with the procedures and to the damage and degradation standards outlined in Volume 6 of the PACE Series and Notetaking Sheet 2-3-1N.

1013

NOTE: Circuit boards may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on component removal and desoldering technique will be offered as information.

### III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in three circuit boards with the minimum number of components removed from each, for grading by the seventh day of the course. Quality of completed work must meet the acceptable standards of no damage or degradation of components or circuit boards to receive a satisfactory (SAT) grade. If the desoldering and component removal is determined to be unsatisfactory (UNSAT), the student will be permitted to rework and resubmit them for grading by the ninth day. Two UNSAT's on the same task will be cause for convening an academic board and possible drop from the course.

### IV. EQUIPMENT:

- A. One 2M kit
- B. One selected single sided printed circuit board
- C. Two selected double sided printed circuit boards
- D. Consumable supplies as necessary

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 2-4

REPAIR OF DAMAGED PRINTED CIRCUIT BOARDS

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Identify the four categories of damage common to printed circuit boards. Identification will be in concurrence with information contained in Notetaking Sheet 2-4-1N.
- B. Determine the extent of repair required and the proper repair technique to be used on any printed circuit board in accordance with information outlined in Notetaking Sheet 2-4-1N and MIL-STD-454D.
- C. Repair damaged printed circuit board conductors, eyelets and laminates using the proper tools and techniques and to the standards outlined in Notetaking Sheet 2-4-1N and MIL-STD-454D.

II. PERFORMANCE:

- A. Repair the conductor damage on an instructor provided printed circuit board following the procedures and to the acceptable standards outlined in Notetaking Sheet 2-4-1N utilizing the high reliability soldering techniques illustrated in MIL-S-45743E. A minimum of one each of the following type conductor repairs is required:
  1. One (1) Flow repair
  2. One (1) Lap repair
  3. One (1) Clinch Staple repair
  4. One (1) Pad replacement with an eyelet set in the pad repair
- B. Perform a laminate repair of a burned area on an instructor provided printed circuit board using the Rebuilding technique and to the acceptable standards outlined in Notetaking Sheet 2-4-1N.

NOTE: Circuit boards may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on conductor and laminate repair techniques will be offered as information.

1615



### III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in the printed circuit boards with the required conductor repairs and laminate repair completed by the ninth day of the course. Quality of completed work must meet the acceptable standards for printed circuit board repair as illustrated in MIL-S-45743E and outlined in Notetaking Sheet 2-4-1N to receive a satisfactory (SAT) grade. If the laminate or conductor repairs are determined to be unsatisfactory (UNSAT), the student will be permitted to rework and resubmit them for grading by the tenth day. Two UNSAT's will be cause for convening an academic board and possible drop from the course.

### IV. EQUIPMENT:

- A. One 2M kit
- B. One printed circuit board with four conductors damaged
- C. One printed circuit board with overheated laminated damage
- D. Epoxy
- E. Scrap circuit board or fiberglass powder
- F. Copper Foil
- G. Consumable supplies as necessary

1616

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 3-1

HAND SOLDERING TURRET TERMINALS

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Connect properly prepared wires to prepared turret terminals, using preferred mounting styles and terminations, with high reliability soldering techniques meeting or exceeding all specifications illustrated in MIL-S-45743E and described in Notetaking Sheet 3-1-1N.

II. PERFORMANCE:

- A. Complete a minimum of two (2) single entry turret terminal connections, after preparing the wires and terminals, using the preferred mounting styles and high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 3-1-1N.
- B. Complete a minimum of one (1) double entry turret terminal connection, after preparing the wires and terminal, using the preferred mounting style and high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 3-1-1N.

NOTE: Turret terminals may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on turret terminal connection techniques will be offered as information.

III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in a minimum of two single entry and one double entry turret terminal connections for grading by the ninth day of the course. Quality of completed work must meet the acceptable standards for turret terminal connections as illustrated in MIL-S-45743E and described in Notetaking Sheet 3-1-1N to receive a satisfactory (SAT) completion grade. If either or both of the connection styles are determined to rework and resubmit them for grading by the tenth day. Two UNSAT's on the same task will be cause for convening an academic board and possible drop from the course.

IV. EQUIPMENT:

- A. One 2M kit
- B. Turret Terminals
- C. Wire
- D. Consumable supplies as necessary

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

## Performance Test 3-2

## HAND SOLDERING HOOK AND PIERCED TAB TERMINALS

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Connect properly prepared wires to prepared hook and pierced tab terminals, using preferred mounting styles and terminations, with high reliability soldering techniques meeting or exceeding all specifications illustrated in MIL-S-45743E and described in Notetaking Sheet 3-2-1N.

II. PERFORMANCE:

- A. Complete a minimum of two (2) single entry and one (1) double entry hook terminal connections, after preparing the wires and terminals, using the preferred mounting styles and high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 3-2-1N.
- B. Complete a minimum of two (2) single entry and one (1) double entry pierced tab terminal connections, after preparing the wires and terminals, using the preferred mounting styles and high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 3-2-1N.

NOTE: Hook and pierced tab terminals may be presented at any time for informal evaluation of work being performed prior to grading. Constructive comments by the instructor on hook and pierced tab terminal connections techniques will be offered as information.

III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in the specified minimum single and double entry hook and pierced tab terminal connections for grading by the ninth day of the course. Quality of completed work must meet the acceptable standards for the terminal connections as illustrated in MIL-S-45743E and described in Notetaking Sheet 3-2-1N to receive a satisfactory (SAT) completion grade. If any of the connections styles are determined to be unsatisfactory (UNSAT) the student will be permitted to rework and resubmit them for grading by the tenth day. Two UNSAT's on the same task will be the cause for convening an academic board and possible drop from the course.

IV. EQUIPMENT:

- A. One 2M kit
- B. Hook and Pierced Tab Terminals 18
- C. Wire
- D. Consumable supplies as necessary

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 3-3

HAND SOLDERING BIFURCATED TERMINALS

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Connect properly prepared wires to prepared bifurcated terminals, using preferred mounting styles and terminations, with high reliability soldering techniques meeting or exceeding all specifications illustrated in MIL-S-45743E and described in Notetaking Sheet 3-3-1N.

II. PERFORMANCE:

- A. Complete a minimum of one (1) each of the following bifurcated terminal connections, after preparing the wires and terminals, using the preferred mounting styles and high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 3-3-1N:

- 1. One (1) Single entry
- 2. One (1) Double entry
- 3. One (1) Top entry
- 4. One (1) Bottom entry

NOTE: Bifurcated terminals may be presented at any time for informal evaluation of work being performed prior to grading. Constructive comments by the instructor on bifurcated terminal connections techniques will be offered for information.

III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in a minimum of one (1) single entry, one (1) double entry, one (1) top and one (1) bottom entry bifurcated terminal connections for grading by the tenth day of the course. Quality of completed work must meet the acceptable standards for bifurcated terminal connections as illustrated in MIL-S-45743E and described in Notetaking Sheet 3-3-1N to receive a satisfactory (SAT) completion grade. If any of the connections are determined to be unsatisfactory (UNSAT), the student will be permitted to rework and resubmit them for grading by the twelfth day. Two UNSAT's on the same task will be cause for convening an academic board and possible drop from the course.

IV. EQUIPMENT:

- A. One 2M kit
- B. Bifurcated terminals
- C. Wire
- D. Consumable supplies as necessary

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

## Performance Test 3-4

## HAND SOLDERING CONNECTOR PINS

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Connect properly prepared wires to prepared solderable connector pins using preferred mounting styles and terminations, with high reliability soldering techniques meeting or exceeding all specifications illustrated in MIL-S-45743E and described in Notetaking Sheet 3-4-1N.

II. PERFORMANCE:

- A. Complete a minimum of five (5) single entry connector pin connections, after preparing the wires and connector pins, using preferred mounting styles and high reliability soldering techniques illustrated in MIL-S-45743E and described in Notetaking Sheet 3-4-1N.

NOTE: Connector pins may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on connector pin connection techniques will be offered as information.

III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in a minimum of five (5) single entry connector pin connections for grading by the tenth day of the course. Quality of completed work must meet the acceptable standards for connector pin connections as illustrated in MIL-S-45743E and described in Notetaking Sheet 3-4-1N to receive a satisfactory (SAT) completion grade. If any connector pin connections are determined to be unsatisfactory (UNSAT), the student will be permitted to rework and resubmit them for grading by the twelfth day. Two UNSAT's on the same task will be cause for convening an academic board and possible drop from the course.

IV. EQUIPMENT:

- A. One 2M kit
- B. Connector pins
- C. Wire
- D. Consumable supplies as necessary

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 4.3

**MICRO-ELECTRONIC CIRCUIT CONFORMAL COATING  
REMOVAL AND DESOLDERING TECHNIQUES**

**I. PURPOSE:**

To determine the proficiency with which the student performs the following tasks:

- A. Remove various conformal coatings from micro-electronic printed circuit boards using the heat, chemical and/or abrasive methods and the necessary tools as outlined in Volume 6 of the PACE Rework and Repair Technology Series and Notetaking Sheet 3-4-1N.
- B. Remove various component parts from micro-electronic printed circuit boards using the correct tools and desoldering techniques as outlined in Volume 6 of the PACE Rework and Repair Technology Series and Notetaking Sheet 3-4-1N.

**II. PERFORMANCE:**

- A. Remove a minimum of two (2) specific dual-in-line components (DIP'S), from an instructor selected conformal coated micro-electronic printed circuit board, using the correct micro conformal coating removal method and micro electronic desoldering techniques as outlined in Volume 6 of the PACE Rework and Repair Technology Series and the information contained in Notetaking Sheet 3-4-1N.
- B. Remove a minimum of two (2) specific flat pack components (FLAT PACK'S), from an instructor selected conformal coated micro-electronic printed circuit board, using the correct micro conformal coating removal method and micro electronic desoldering techniques as outlined in Volume 6 of the PACE Rework and Repair Technology Series and the information contained in Notetaking Sheet 3-4-1N.
- C. Remove a minimum of two (2) specific integrated circuits (TO-5 IC's), from an instructor selected conformal coated micro-electronic printed circuit board, using the correct micro conformal coating removal method and micro electronic desoldering techniques as outlined in Volume 6 of the PACE Rework and Repair Technology Series and the information contained in Notetaking Sheet 3-4-1N.

NOTE: Micro-electronic circuit boards may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on micro coating removal and desoldering techniques will be offered as information.

### III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in the completed circuit boards with a minimum of two (2) specific components removed from each circuit board for grading by the thirteenth day of the course. Removal of the coated components must be performed with no damage or degradation to the components or circuit boards and meet the acceptable standards outlined in Volume 6 of the PACE Rework and Repair Series and Notetaking Sheet 3-4-1N to receive a satisfactory (SAT) completion grade. If any circuit board is determined to be unsatisfactory (UNSAT), the student will be permitted to rework and resubmit them for grading, by the fourteenth day. Two UNSAT's on the same task will be cause for convening an academic board and possible drop from the course.

### IV. EQUIPMENT:

- A. One 2M Kit
- B. One conformal coated micro circuit board with dual-in-line components
- C. One conformal coated micro circuit board with Flat pack components
- D. One conformal coated micro circuit board with TO-5 IC components
- E. Consumable supplies as necessary

1022

PLEASE READ COMPLETE DIRECTIONS BEFORE PROCEEDING

Performance Test 4-4

MICRO-ELECTRONIC CIRCUIT SOLDERING TECHNIQUES

I. PURPOSE:

To determine the proficiency with which the student performs the following tasks:

- A. Replace selected components parts on micro-electronic circuit boards using the correct tools and high reliability soldering techniques to the acceptable standards illustrated in MIL-S-45743E and described in Notetaking Sheet 4-4-1N.

II. PERFORMANCE:

- A. Install a minimum of two (2) dual-in-line (DIP's) components on an instructor-selected micro-electronic circuit board using preferred mounting and termination styles and high reliability soldering techniques to the acceptable standards outlined in MIL-STD-454D, MIL-S-45743E and Notetaking Sheet 4-4-1N.
- B. Install a minimum of two (2) flat pack (FLAT PACK's) components on an instructor selected micro-electronic circuit board using preferred mounting and termination styles and high reliability soldering techniques to the acceptable standards outlined in MIL-STD-454D, MIL-S-45743E and Notetaking Sheet 4-4-1N.
- C. Install a minimum of two (2) integrated circuit (TO-5-IC's) components on an instructor selected micro-electronic circuit board using preferred mounting and termination styles and high reliability soldering techniques to the acceptable standards outlined in MIL-STD-454D, MIL-S-45743E and Notetaking Sheet 4-4-1N.

NOTE: Micro-electronic circuit boards may be presented at any time for informal evaluation on work being performed prior to grading. Constructive comments by the instructor on installation of micro components and soldering techniques will be offered as information.



### III. TIME REQUIRED PER STUDENT:

Each student will be required to turn in the completed micro-electronic circuit boards with a minimum of two (2) specific components installed on each board for grading by the fourteenth day of the course. Installation of the components must meet the acceptable standards outlined in MIL-S-45743E and Notetaking Sheet 4-4-1N to receive a satisfactory (SAT) completion grade. If any circuit board is determined to be unsatisfactory (UNSAT), the student will be permitted to rework and resubmit them for grading by the fifteenth day. Two UNSAT's on the same task will be cause for convening an academic board and possible drop from the course.

### IV. EQUIPMENT:

- A. One 2M Kit
- B. Two dual-in-line (DIP's) components
- C. Two flat pack (FLAT PACK's) components
- D. Two TO-5-IC's
- E. Three micro-circuit boards
- F. Consumable supplies as necessary

1624

broad range of marketing occupations, that unneeded duplication is avoided, and that a greater consistency of research design is maintained. Consideration needs to be given to other curriculum models; additional evaluative studies should be conducted to measure the effectiveness of competency-based programs.

Research focused on evaluation has been refined during the ten-year period. While much of the evaluation is still opinion-based, the development of evaluative criteria and standards should provide an objective base for future evaluation. Initial efforts in cost-benefit analysis have been undertaken. Such studies provide extremely important information for educational decision makers. Researchers should formulate and test additional evaluative models including comprehensive cost-benefit analysis and measures of worker productivity. Goal-free assessment should be examined in order to provide a unique perspective for the analysis of the marketing and distributive education programs.

Innovative research designs and valuable data are results available from research in the area of instruction. Comparative studies that have been completed though opinion analysis are still predominate. The development of quasi-experimental and experimental research should be most easily accomplished in this program area.

Finally, the area of philosophy and objectives for marketing and distributive education must be carefully scrutinized. There is no standard set of goals and objectives accepted by the profession. The philosophy identified by Crawford in 1967 and revalidated in 1975 appears to have a high level of acceptance in the profession, as shown in Crawford's research and later studies incorporating the philosophical statements. However, it must be noted that despite the high level of acceptance of the philosophical statements, many studies have shown that significant portions of the philosophy are not implemented effectively. Attention must be focused in future research on the apparent discrepancy between philosophy and practice.

## RECOMMENDATIONS

Research is playing an increasingly important role in marketing and distributive education. With increased dissemination and application of research results, decision making in marketing and distributive education should become much more objective and effective. Dissemination of research results is critical but difficult, particularly as the quantity of research increases.

given to broadening the outlets for dissemination. and briefs that stress major findings and ons should be widely disseminated. Monographs iled analysis of relevant research on a ssue should be prepared. The marketing and ion profession should consider the development of relevant research or some other method of sifying research on a continuing basis. Future and Synthesis of Research in Marketing and ion should be published on a regular basis. xt edition should begin immediately to aid in a comprehensive publication.

ned in marketing and distributive education, iven to the potential usefulness of the ns and designs should be selected to and replicability of the study. Previous within and outside of marketing and ion should be carefully reviewed to provide for istency of effort.

earch

base of research is developing in marketing and ion, several areas are in need of specific opics of human resource needs and employment istration and supervision, and guidance and /iously been identified as receiving limited

.t are of specific interest to the profession, io research devoted to them include:

1 adult students and instruction devoted  
g and retraining marketing personnel.

1 special needs populations in marketing and

al research evaluating alternative  
ial models and strategies.

of teacher education, program models, inservice  
and preparation of teachers using  
onal strategies.

ion of marketing and distributive education  
.tive human resource development system.

6. The development and testing of nontraditional program strategies both inside and outside the public educational system.
7. The development of transportable research models that can be easily implemented at state and local levels.

A need exists in marketing and distributive education to critically analyze past research and to develop a comprehensive, specific plan for future research. As questions and issues are identified within the profession, a framework should be available to promote careful study and the search for answers to questions. Research coupled with dissemination and application will be a positive element in the future development of marketing and distributive education.

TABLE 1  
DOCTOR'S AND OTHER STUDIES  
IN MARKETING AND DISTRIBUTIVE EDUCATION  
1968-1980

Year	68*	69	70	71	72	73	74	75	76	77	78	79**	80**	Total
Doctor's Studies	4	9	10	11	11	10	13	12	19	25	13	10	1	148
Other Studies	1	2	3	4	2	5	5	13	13	12	13	7	0	80
Total	5	11	13	15	13	15	18	25	32	37	26	17	1	228

\* Does not include the studies reported by Ashmun and Larson for 1968.

\*\* Only those studies reported to the authors for 1979 and 1980 are included. A comprehensive search was conducted for the years, 1969-1978.

TABLE II

REFERENCES MADE TO STUDIES  
REPORTED BY YEARS AND SUBJECTS

Subject Area	68*	69	70	71	72	73	74	75	76	77	78	79**	80**	Total
I. Philosophy and Objectives														
Dissertations		1		1	1	2	2	1	1	3	2	1		15
Others								1						1
Total	0	1	0	1	1	2	2	2	1	3	2	1	0	16 (6.6%)
II. Human Resource Needs and Employment Opportunities														
Dissertations				1										1
Others		1					1			1	1			4
Total	0	1	0	1	0	0	1	0	0	1	1	0	0	5 (2.1%)
III. Learner Characteristics														
Dissertations	1			1	1		1	1		1				6
Others				1				1		1				3
Total	1	0	0	2	1	0	1	2	0	2	0	0	0	9 (3.7%)
IV. Curriculum														
Dissertations	1	2	2	1	2	2	1		1	3	3	2		20
Others			1	1					7	5	2	1	1	18
Total	1	2	3	2	2	2	1	7	8	8	5	3	1	38 (15.6%)
V. Program Design Models														
Dissertations			1		1									2
Others						1			1	1	1			4
Total	0	0	1	0	1	1	0	0	1	1	1	0	0	6 (2.4%)

TABLE II, con't.

Subject Area	68*	69	70	71	72	73	74	75	76	77	78	79**	80**	Total
VI. Instruction														
Dissertations	2	4	2	1	2	1	3	2	7	6	6	2	1	39
Others				2	1	1	3	3	6	2	4	4		26
Total	2	4	2	3	3	2	6	5	13	8	10	6	1	65 (26.8%)
VII. Guidance and Counseling														
Dissertations					1				1	1				3
Others								1						1
Total	0	0	0	0	1	0	0	1	1	1	0	0	0	4 (1.7%)
VIII. Teacher Education														
Dissertations			4	3	2	2	3	4	6	10		3		37
Others		1	1	1	1			2	1	3	1	3		14
Total	0	1	5	4	3	2	3	6	7	13	1	6	0	51 (21.0%)
IX. Administration and Supervision														
Dissertations							1		1			1		3
Others					1			1			1			3
Total	0	0	0	0	1	0	1	1	1	0	1	1	0	6 (2.4%)
X. Evaluation														
Dissertations		2	1	4	1	3	4	5	3	3	1	2		29
Others	1	2	1		1	2	1	2	1	2	1			14
Total	1	4	2	4	2	5	5	7	4	5	2	2		43 (17.7%)
TOTAL BY YEAR														
Dissertations	4	9	10	12	11	10	15	13	20	27	12	11	1	155
Others	1	5	3	4	4	4	5	18	14	12	10	8	0	88
TOTAL	5	14	13	16	15	14	20	31	34	39	22	19	1	243 (100%)

\* Does not include the studies reported by Ashmun and Larson for 1968.

\*\* Only those studies reported to the authors for 1979 and 1980 are included. A comprehensive search was conducted for the years 1969-1978.

TABLE III  
FREQUENCY WITHIN AREAS OF RESEARCH

Area of Research	Number of Studies	Percent
1. Instruction	65	26.8
2. Teacher Education	51	21.0
3. Evaluation	43	17.7
4. Curriculum	38	15.6
5. Philosophy and Objectives	16	6.6
6. Learner Characteristics	9	3.7
7. Program Design Models	6	2.4
8. Human Resource Needs and Employment Opportunities	5	2.1
9. Administration and Supervision	6	2.4
10. Guidance and Counseling	4	1.7
TOTAL	243	100.0%



## REFERENCES

### PHILOSOPHY AND OBJECTIVES

- Bradley, D., III. Identifying, Validating, and Selecting Objectives for Postsecondary Distributive Education. Ed.D. dissertation, Columbia: University of Missouri, 1978.
- Callahan, R. The Identification of Goals for the Junior Collegiate Division of the Distributive Education Clubs of America. Ed.D. dissertation, Auburn, Alabama: Auburn University, 1979.
- Christianson, L. Identification, Refinement, and Rankings of Goals and Objectives for the National Association of Distributive Education Teachers. Ed.D. dissertation, Grand Forks: University of North Dakota, 1977.
- Corbin, S. Formulation of Goals and Objectives for the High School Division of Distributive Education Clubs of America. Ed.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1976.
- Crawford, L. A Philosophy of Distributive Education: A Report of the First Step in the Research Project to Identify a Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education. Blacksburg: Virginia Polytechnic Institute and State University, 1967. (ED 019 412)
- \_\_\_\_\_. A Philosophy of Distributive Education. Blacksburg: Virginia Polytechnic Institute and State University, 1975.
- Davis, R. The Extent to Which Indiana Distributive Education Programs are Achieving Program Philosophy as Perceived by Students and Teacher-Coordinators. Ed.D. dissertation, Tempe: Arizona State University, 1977.
- Decker, R. Aims, Objectives, and Need for Distributive Education in Arizona. Ed.D. dissertation, Tempe: Arizona State University, 1977.
- Doonan, T. A Philosophy of Distributive Education - 1974. A Comparison of Philosophies Held by Leaders in 1965 with Those in 1974. Ph.D. dissertation, E. Lansing: Michigan State University, 1975.

- Ertel, K. Clusters of Tasks Performed by Merchandising Employees Working in Three SICs of Retail Establishments. Final Report No. 20. Moscow: Idaho University, 1968. (ED 023 911)
- Furtado, L. An Interpretive History of Distributive Education, 1936-1972, as Seen by Selected National Leaders. Ph.D. dissertation, E. Lansing: Michigan State University, 1973.
- Harris, E. Evaluative Criteria and Standards for Distributive Education on the Secondary Level. DeKalb: Northern Illinois University, 1978.
- Houstman, J. The Future of Vocational Office and Distributive Education as Perceived by State Supervisors and Teacher Educators. Ed.D. dissertation, Tempe: Arizona State University, 1972.
- Kinzer, L. The Philosophy of Distributive Education Teacher Coordinators as Compared to Business and Office Education Teacher Coordinators in New Mexico. Ed.D. dissertation, Tempe: Arizona State University, 1969.
- Little, M. Objectives and Evaluative Criteria for Distributive Education Programs at the Secondary Level in Michigan. Ph.D. dissertation, E. Lansing: Michigan State University, 1978.
- Lynch, R. and Kohns, D. Proposed Design and Broad Content Outlines for Teacher and Professional Educator Materials in the Field of Marketing and Distribution. Blacksburg: Virginia Polytechnic Institute and State University, 1977.
- National Study of Secondary School Evaluation. Evaluative Criteria for the Evaluation of Secondary Schools. Washington, D.C: American Council on Education, 1969.
- Reece, B. Adult Distributive Education Issues in 1970. Ed.D. dissertation, Lincoln: University of Nebraska, 1971.
- Ricci, F. The Nature of Retail Education with Implications for Curricular Development for Postsecondary Institutions in New England. Ed.D. dissertation, Boston, Massachusetts: Boston University, 1972.
- Shoemaker, P. Current Issues in Adult Distributive Education in Ohio. Ph.D. dissertation, Athens: The University of Ohio, 1973.

Strydesky, R. The Validation of Evaluative Standards and Criteria for Distributive Teacher Education Through Use of the Delphi Technique. Ph.D. dissertation, College Park: University of Maryland, 1977.

Torres, J. Business and Distributive Education in the Public Secondary Schools of Puerto Rico: An Historical Study of the Period 1898-1972. Ph.D. dissertation, New York: New York University, 1979.

Weatherford, J. Identification and Analysis of Issues in Distributive Education. Ph.D. dissertation, Columbus: The Ohio State University, 1972.

Whitted, M. Criteria for the Evaluation of Two-Year Federally Reimbursed Distributive Education Programs in the Junior College. Ed.D. dissertation, Bloomington: Indiana University, 1969.

#### HUMAN RESOURCE NEEDS AND EMPLOYMENT OPPORTUNITIES

Devitt, M. and Leonard, K. Identification and Analysis of Distributive Education Curricular Needs by Job Title. Indianapolis, Indiana: State Board of Vocational and Technical Education, 1977.

Egglund, S. The Development of a Hierarchy of Need for Specialized Distributive Education Programs in Postsecondary Schools in Nebraska. Lincoln: University of Nebraska, 1974. (ED 105 201)

Gildan, K. Development of an Instructional Program to Prepare Distributive Education Teacher Coordinators to Teach the Educable Mentally Handicapped. Boca Raton: Florida Atlantic University, 1977.

Patton, L. An Analysis of Curriculum and Employment Needs in Postsecondary Distributive Education Programs in Oklahoma. Ed.D. dissertation, Stillwater: Oklahoma State University, 1971.

Samson, H. The Nature and Characteristics of Middle Management in Retail Department Stores. Madison: The University of Wisconsin, School of Education, 1969. (ED 051 394)

## LEARNER CHARACTERISTICS

- Allen, T. A Comparison of Distributive Education Majors in Terminal Programs with Other Curriculum Majors in Transfer Programs on Selected Variables. Ed.D. dissertation, Athens: University of Georgia, 1971.
- Boucher, H. Job Satisfaction and Expectations of Distributive Education Graduates. Ph.D. dissertation, Manhattan: Kansas State University, 1977.
- Crawford, L. A Philosophy of Distributive Education. Blacksburg: Virginia Polytechnic Institute and State University, 1975.
- Gildan, K. Development of an Instruction Program to Prepare Distributive Education Teacher-Coordination to Teach the Educable Mentally Handicapped. Boca Raton: Florida Atlantic University, Florida State Department of Education, 1977.
- Harris, E. Employer Preferences and Teacher-Coordinator Practices in Distributive Education. DeKalb: Northern Illinois University, 1971. (ED 049 392)
- Hoffman, K. Development of an Instrument to Assess the Composite Subject Matter Achievement of Secondary Cooperative Distributive Education Students in Ohio. Ph.D. dissertation, Columbus: The Ohio State University, 1968.
- Lundell, W. The Relationships of Selected Characteristics and Program Experiences of 1968 Minnesota Distributive Education High School Graduates to their Post High School Occupational and Educational Status Five Years Later. Ph.D. dissertation, Minneapolis: University of Minnesota, 1975.
- Moore, E. The Development of a Multi-Variate Formula to Predict Occupational Work Experience Success of Distributive Education Students. Ed.D dissertation, College Park: University of Maryland, 1974.
- Senning, W. Factors Contributing to the Enrollment of Disadvantaged (Especially Black) in Junior College Marketing and Related Management Programs. Ed.D. dissertation, Boca Raton: Florida Atlantic University, 1972.
- Sita, M. Relationships Between Perceived Program Adequacy and Personal, Educational, and Occupational Characteristics of Adult Distributive Education Students in Community Colleges of Arizona. Ph.D. dissertation, Tempe: Arizona State University, 1974.

## CURRICULUM

- Ball, H. A Congruency Study of the Training Needs of Middle Management in Department Stores as Perceived by Postsecondary Marketing Educators and Businessmen in the Department Store Industry. Ph.D. dissertation, Madison: The University of Wisconsin, 1970.
- Berger, D. and Lokai, L. An Analysis of the Agricultural Supply Business and Services Occupation. Columbus: The Ohio State University, Trade and Industrial Education Instructional Laboratory, 1976. (ED 151 526)
- Bohac, R. and Vernon, R. An Analysis of the Automobile Sales Occupation. Columbus: The Ohio State University, Trade and Industrial Education Instructional Laboratory, 1975. (ED 107 951)
- Brown, K. Distributive Education in the High School. Washington, D.C.: U.S. Office of Education, 1963.
- Carmichael, J. An Analysis of Activities of Middle Management Personnel in the Retail Trades Industry with Implications for Curriculum Development in Postsecondary Institutions. Ph.D. dissertation, E. Lansing: Michigan State University, 1968.
- Christ, C. and Deluzin, J. An Analysis of the Auto Parts Counterperson Occupation. Columbus: The Ohio State University, Trade and Industrial Education Instructional Laboratory, 1975. (ED 107 950)
- Cook, F. et al. Senior Year Intensified Demonstration Curriculum Program. Detroit: Wayne State University, Department of Business and Distributive Education, 1970. (ED 040 297)
- Crawford, L. A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education. Blacksburg: Virginia Polytechnic Institute and State University, 1967. (ED 032 383)
- Devitt, M. and Leonard, K. Identification and Analysis of Distributive Education Curricular Needs by Job Title. Indianapolis, Indiana: State Board of Vocational and Technical Education, 1977.
- Dietrich, L. Competency Patterns in Selected Distributive/Marketing Jobs in Florida's Tourism-related Industries as a Basis for Educational Planning. Ed.D dissertation, Boca Raton: Florida Atlantic University, 1976.

- Edwards, T. et al. An Empirical Determination of Tasks Essential to Successful Performance as a Retail Landscape and Garden Store Salesman. Columbus: The Ohio State University, Department of Agricultural Education, 1975. (ED 115 793)
- Egglund, S. The Determination and Verification of Economic Competencies Required of Persons Employed in Distributive Occupations. Lincoln: University of Nebraska, Department of Business Education, 1976.
- Ely, V. The Distributive Education Program. Washington, D.C.: U.S. Office of Education, 1978. (ED 160 827)
- Ertel, K. Identification of Major Tasks Performed by Merchandising Employers Working in Three Standard Industrial Classifications of Retail Establishments. Moscow: University of Idaho, 1966. (ED 010 657)
- Fishco, R. A Comparison of the Training Needs of Potential Mid-Management Retail Executives as Perceived by Retail Presidents or Vice Presidents and Retail Employment Executives of Retail Department Stores. Edison, New Jersey: Middlesex County College, 1976.
- Gildan, K. Development of an Instructional Program to Prepare Distributive Education Teacher Coordinators to Teach the Educable Mentally Handicapped. Boca Raton: Florida Atlantic University, 1977.
- Golden, E. An Analysis of Marketing Competencies Needed in Agribusiness for the Determination of Middle Level Management Curriculum Models. Ed.D. dissertation, DeKalb: Northern Illinois University, 1970.
- Harestad, C. et al. An Analysis of the Real Estate Occupation. Columbus: The Ohio State University, Trade and Industrial Education Instructional Laboratory, 1975. (ED 107 978)
- Harris, E. Curriculum Research for the Development of Marketing and Distributive Education Curriculum Guides in the State of Illinois. DeKalb: Northern Illinois University, 1978.
- \_\_\_\_\_. Evaluative Criteria and Standards for Distributive Education on the Secondary Level. DeKalb: Northern Illinois University, 1978.
- Harrison, W., Jr. "Learning Activity Packages: A Progress Report." DE Today. 7(February, 1973): 2.

- Levere, W. A Study of Distributive Education Students' Perceptions and Attitudes Toward Secondary Distributive Education Teachers in Utah. Ed.D. dissertation, Logan: Utah State University, 1976.
- Litchfield, C. and Smith, W. A National Study of Occupational Experience Certification Requirements for Distributive Education Teacher-Coordination and of Directed Occupational-Experience Opportunities Provided Through Distributive Teacher Education Programs. Blacksburg: Virginia Polytechnic Institute and State University, 1977.
- Little, W. Relationships Between Certain Personality Characteristics of Postsecondary Distributive Education Personnel and Job Satisfaction. Ph.D. dissertation, Minneapolis: University of Minnesota, 1972.
- Lucas, S. and Weber, L. The Improvement of Evaluation Procedures of Teachers of Distribution and Marketing. Skokie, Illinois: Sears, Roebuck Foundation; Richmond: Virginia State Department of Education, 1970. (ED 047 130)
- Mayleben, D. Four Broad Components of Personality as It Relates to the Perceived Effectiveness of the Distributive Education Student-teachers and Their Students in Minnesota. Ph.D. dissertation, E. Lansing: Michigan State University, 1973.
- Miller, J. A Factor Analysis of Professional Education Competencies and Selected Community College Instructors. Ph.D. dissertation, Corvallis: Oregon State University, 1971.
- Olsen, R. A Study of the Occupational Experience of Distributive Education Teacher Coordinators and Its Relationship to Businessmen Ratings of Programs, Student Competencies, and Ratings from the Results of Follow-Up Studies on Graduates. Ed.D. dissertation, Moscow: University of Idaho, 1971.
- Parker, R. Evaluation of the Effectiveness of LAPs as Part of the Distributive Education Curriculum in Tennessee. Ed.D. dissertation, Knoxville: The University of Tennessee, 1979.
- Renshaw, P. Basic Marketing and Marketing Related Knowledges for Secondary School Distributive Education Instructional Personnel. Ph.D. dissertation, Minneapolis: University of Minnesota, 1976.
- Riley, E. An Experimental Comparison of the Effects of Three Methods of Conducting Visitation Conferences in Cooperative Distributive Education Programs. Ed.D. dissertation, Columbia: University of Missouri, 1970.



- Hogan, D. Economic Understandings Needed by Secondary School Distributive Education Teachers. Ph.D. dissertation, Tempe: Arizona State University, 1977.
- \_\_\_\_\_. Implementation of Vocational Education in Distribution. Report of a USOE Clinic. Minneapolis: University of Minnesota, School of Education, 1978.
- Jacobs, B. A Study to Identify a Competency Pattern for the Manufacturer's Salesperson. Ph.D. dissertation, Minneapolis: University of Minnesota, 1978.
- James, R. Competencies for the Most Common First-Level Marketing Positions in Food Marketing, General Retail Merchandising, and Wholesaling. Ed.D. dissertation, DeKalb: Northern Illinois University, 1978.
- Kirk, H. Educational Needs for Mid-Management Personnel in Florida with Implications for Curricular Development. Ed.D. dissertation, Boca Raton: Florida Atlantic University, 1969.
- Kitzmiller, C. et al. An Analysis of the Industrial Sales Occupation. Columbus: The Ohio State University, Trade and Industrial Education Instructional Laboratory, 1973. (ED 107 965)
- LaSalle, K. Retail Education: A Process-Centered Cooperative Education Curriculum for Massachusetts Community Colleges. Ed.D. dissertation, Boston, Massachusetts: Boston University, 1973.
- Leventhal, J. A Study of Curriculum of Selected Two-Year Postsecondary Marketing and Distribution Programs. Ed.D. dissertation, Buffalo: State University of New York, 1970.
- Lynch, R. and Kohns, D. Proposed Design and Broad Content Outlines for Teacher and Professional Educator Materials in the Field of Marketing and Distribution. Blacksburg: Virginia Polytechnic Institute and State University, 1977.
- Malina, V. MODELS (Modern Office and Distributive Education Learning Systems). . A Systematic Analysis of Selected Jobs in the Hotel Industry. Ph.D. dissertation, Los Angeles: University of California, 1978.
- McAnelly, J. A Study of the Mathematical Competencies Considered Important by Supervisors in Large Retail Firms in the Metropolitan Area of Chicago. Ed.D. dissertation, DeKalb: Northern Illinois University, 1977.



- Miller, M. Critical Requirements for the Socioeconomically Disadvantaged Employed in Retail Jobs in Columbus, Ohio. Ph.D. dissertation, Columbus: The Ohio State University, 1969.
- Moore, G. et al. An Analysis of the Insurance Sales Occupation. Columbus: The Ohio State University, Trade and Industrial Education Instructional Laboratory, 1975. (ED 107 966)
- Palmore, T. A Study of Selling Competencies and Their Priorities for Inclusion in the Distributive Education Curriculum. Ph.D. dissertation, Albuquerque: University of New Mexico, 1972.
- Patterson, J. The Determination of Competencies in the Hotel-Motel Industry with Implications for Curriculum Development for Post-Secondary Distributive Education Cooperative Students in Philadelphia, Pennsylvania. Ed.D dissertation, Philadelphia, Pennsylvania: Temple University, 1974.
- Patton, L. An Analysis of Curriculum and Employment Needs in Post-Secondary Distributive Education Programs in Oklahoma. Ed.D dissertation, Stillwater: Oklahoma State University, 1971.
- Pope, B. Development of a Data Base for Curriculum Development in Distribution and Marketing. Richardson, Texas: EPD Consortium D., 1976.
- Ricci, R. The Nature of Retail Education with Implications for Curriculum Development for Postsecondary Institutions in New England. Ph.D. dissertation, Boston, Massachusetts: Boston University, 1972.
- Samson, H. The Nature and Characteristics of Middle Management in Retail Department Stores. Madison: The University of Wisconsin, School of Education, 1969. (ED 051 394)
- \_\_\_\_\_ and Rathert, M. A Survey of the Importance of Basic Marketing Concepts and the Extent of Their Coverage in the IDECC System. Madison: The University of Wisconsin, 1976.
- Sedlik, D. Marketing Research Competencies Needed by Middle-Level Management in Selected Fields of Distribution in the State of Illinois. Ed.D. dissertation, DeKalb: Northern Illinois University, 1973.
- Shell, V. Computational Concepts and Tasks Associated with Entry Level General Merchandising Employees in the Columbus, OH; Louisville, KY; and Nashville, TN Areas. Ph.D. dissertation, Columbus: The Ohio State University, 1979.

- Vocational-Technical Education Consortium of States. Fourth Progress and Information Report. Atlanta, Georgia: Southern Association of Colleges and Schools, 1977. (ED 154 109)
- Weber, J. The Development and Testing of Career Education Curriculum Materials in Selected Distributive Occupations for the Motivation Program Students of the School District of Philadelphia. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1979.
- Williams, T. et al. Task Validation of 16 General Merchandising Department Store Occupations. Washington, D.C.: USOE, 1979.
- Yoder, E. and McCracken, J. An Empirical Determination of Tasks Essential to Successful Performance as an Agricultural-Industrial Equipment Dealership Partsman. Determination of a Common Core of Basic Skills in Agribusiness and Natural Resources. Columbus: The Ohio State University, Department of Agricultural Education Research Foundation, 1975. (ED 115 813)

#### PROGRAM DESIGN MODELS

- Allen, T. An Evaluation of the Implementation of the On-the-Job Non-Pay Training Concept in Secondary Cooperative Vocational Educational Programs in West Virginia. Huntington, West Virginia: Marshall University, Graduate School, 1977.
- Basseri, J. A Design for Cooperative Merchandising Mid-Management Training in the California Public Community College. Ph.D. dissertation, Los Angeles: University of California, 1970.
- Crawford, L. Developing and Testing Simulated Occupational Experiences for Distributive Education Students in Rural Communities. Blacksburg: Virginia Polytechnic Institute and State University, 1976. (ED 118 997)
- Elias, J. and Reece, B. Development of a Model for Distributive Education in Area Vocational Schools in Missouri. Columbia: University of Missouri, Missouri State Department of Education, 1978. (ED 166 371)
- Lancaster, R. A Facilities Model for Laboratory Experiences in Junior College Distributive Education. Ed.D. dissertation, Gainesville: The University of Florida, 1972.

Shapiro, W. Education for Living: A Model Distributive Education Program. Philadelphia, Pennsylvania: Dorrance and Company, 1973. (ED 095 299)

## INSTRUCTION

Allen, T. An Evaluation of the Implementation of the IDECC LAPS Program in Secondary Cooperative Vocational Education Programs in West Virginia. Huntington, West Virginia: Marshall University, Graduate School, 1976.

Ammerman, H. and Essex, D. Performance Content for Job Training. Columbus: The Ohio State University, The National Center for Research in Vocational Education, 1977. (ED 146 370)

Ammerman, H. and Pratzner, F. Performance Content for Job Training: Introduction. Columbus: The Ohio State University, The National Center for Research in Vocational Education, 1977. (ED 146 369)

Anderton, M. The Relationship Between Selected Variables and the Attitudes of Distributive Education Coordinators Toward IDECC Learning Activity Packages. Ph.D. dissertation, Columbus: The Ohio State University, 1976.

Bailey, W. The Effect of Leadership Training on the Attitudes of Student Officers in the Distributive Education Clubs of America. Ed.D. dissertation, Auburn, Alabama: Auburn University, 1979.

Banister, T. Evaluation of Facilities, Equipment, and Instructional Resources in Distributive Education Programs in Arkansas. Ed.D. dissertation, Fayetteville: University of Arkansas, 1969.

Berkowitz, A. Part-Time Versus Alternate-Week Work Schedules As An Influence on the Educational Progress and Attitudes of Cooperative Vocational Distributive Education Students. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1974.

Berns, R. Attitudes of Secondary Distributive Education Teacher-Coordinators and Students Toward Selected Teaching Techniques Using the Semantic Differential. Ph.D. dissertation, Columbus: The Ohio State University, 1978.

\_\_\_\_ and Smith, C. A Competency-Based Inservice Training Program for Distributive Education Coordinators on Their Role as DECA Chapter Advisors. Blacksburg: Virginia Polytechnic Institute and State University, Virginia State Department of Education, 1979. (ED 171 996)

- Blackwell, J. A Descriptive Study of Alabama Teacher-Coordinator Reactions to the Implementation of the Competency-Based Curriculum in Distributive Education. Ed.D. dissertation, Tuscaloosa: University of Alabama, 1978.
- Boulware, G. An Analysis of the Mathematical Skill Learning Activity Packages Developed by the Interstate Distributive Education Curriculum Consortium. Ph.D. dissertation, Columbia: University of South Carolina, 1976.
- Callahan, R. The Identification of Goals for the Junior Collegiate Division of the Distributive Education Clubs of America. Ed.D. dissertation, Auburn, Alabama: Auburn University, 1979.
- Casterline, L. Effects of Training Plans on the Perceptions of Distributive Education as a Training Program. Ph.D. dissertation, Columbus: The Ohio State University, 1974.
- Clark, A. An Analysis of Leadership and Self-Confidence and/or Self-Acceptance Outcomes from Student Participation in Distributive Education Clubs of America. Ph.D. dissertation, Minneapolis: University of Minnesota, 1978.
- Cornell, W. The Relationship of DECA Membership and Career Maturity. Ed.D. dissertation, New Brunswick, New Jersey: Rutgers - The State University, 1977.
- Corbin, S. Formulation of Goals and Objectives for the High School Division of the Distributive Education Clubs of America. Ed.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1975.
- Crawford, L. A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education. Blacksburg: Virginia Polytechnic Institute and State University, 1967. (ED 032 383)
- \_\_\_\_\_. A Philosophy of Distributive Education. Blacksburg: Virginia Polytechnic Institute and State University, 1975.
- \_\_\_\_\_. Developing and Testing Simulated Occupational Experiences for Distributive Education Students in Rural Communities. Blacksburg: Virginia Polytechnic Institute and State University, 1976. (ED 118 997)
- Cunningham, W. A Comparison of the IDECC Learning Activity Packages with a Conventional Presentation in Distributive Education. Ed.D. dissertation, Knoxville: University of Tennessee, 1976.

- Cushman, R. The Relationship Between Selected Characteristics of Secondary Distributive Education Programs and Initial Job Employment or College Entrance. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1973.
- Dailey, R. "A Profile of DECA and Perceptions Concerning Functional and Operational Beliefs." CDTE Bulletin 30. 1977.
- Distributive Education Clubs of America. Evaluation of the DECA National Competency-Based Competitive Events. Reston, Virginia: 1976, 1977, 1978.
- Ditzenberger, R. Perceived Barriers to Implementing a Distributive Education Competency-Based Learning System. Ph.D. dissertation, Ames: Iowa State University, 1976.
- \_\_\_\_\_. DECA Competency-Based Written Event Evaluations. Reston, Virginia: DECA, 1977, 1978, 1979.
- Doneth, J. Teaching Beliefs and Classroom Methodology of Selected Project and Cooperative Plan Distributive Education Teacher-Coordination. Ed.D. dissertation, DeKalb: Northern Illinois University, 1959.
- EduTek, Inc. An Evaluation of the New Competitive Events Designed for the Distributive Education Clubs of America's National Career Development Conference. Lincoln, Nebraska, 1975.
- Eggland, S. and Lynch, R. A Process Evaluation of the New Competitive Events at the Distributive Education Clubs of America Mini-Conference. Reston, Virginia: DECA, 1974.
- Garblik, I. Development of a Transparency Program for Teaching of Introductory Textiles, in Selected Areas of Distributive Education. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1972.
- Gleason, J. The Relationship of Sex and Selected Distributive Education Program Variables with Entry into Distributive Occupations After High School Graduation. Ph.D. dissertation, Columbus: The Ohio State University, 1979.
- Glendale Union High School District 205. A Classroom Training Conference for Youth Leaders of Distributive Education in Arizona Vocational Education. Glendale: Arizona Occupational Research Coordinating Unit, 1975. (ED 112 206)
- Golabek, D. An Investigation to Determine the Relative Effectiveness of the Consumer Game in Distributive Education Classes at the Secondary Level. Ed.D. dissertation, New Brunswick, New Jersey: Rutgers - The State University, 1973.

- Harris, E. Employer Preferences and Teacher-Coordinator Practices in Distributive Education. DeKalb: Northern Illinois University, 1971. (ED 049 392)
- Holt, D. Perceptions of Students, Teacher-Coordinators, and Training Station Employers Regarding the Effectiveness of Distributive Education Clubs of America. Ed.D. dissertation, Commerce: East Texas State University, 1978.
- Holup, J., Jr. A Semantic Differential Study of the Connotative Meaning of Thirty Distributive Education Concepts. Ph.D. dissertation, Pullman: Washington State University, 1980.
- Hutt, R. Perceptions of Employers Regarding Cooperative Distributive Education Programs at the Secondary Level. Ph.D. dissertation, E. Lansing: Michigan State University, 1975.
- Kozma, J. An Analysis of Job Training Stations in Cooperative Distributive Education Programs in Florida Community College - Fall Semester 1978. Ed.D. dissertation, Boca Raton: Florida Atlantic University, 1978.
- Lancaster, R. A Facilities Model for Laboratory Experiences in Junior College Distributive Education. Ed.D. dissertation, Gainesville: The University of Florida, 1972.
- Litchford, C. A Case Study of Training Sponsor Perceptions Regarding the Coordination Phase of Secondary Cooperative-Plan Distributive Education Programs in Roanoke City and County, Virginia. Ed.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1977.
- Lynch, R. and White, T. Training Plans for High School Cooperative Education Programs: A Developmental Project. Bloomington: Indiana University, Indiana Department of Public Instruction, Division of Vocational Education, 1971.
- Maglio, J. Survey of the Interstate Distributive Education Curriculum as Utilized by Wisconsin High School Distributive Education Teacher-Coordinators. Masters thesis, Menomonie: University of Wisconsin-Stout, 1978.
- McComas, M. A Study of the Regional Development of the Distributive Education Clubs of America in the Southern and North Atlantic Regions. Ed.D. dissertation, Auburn, Alabama: Auburn University, 1978.
- McLean, G. Attitudes of Minnesota Office and Distributive Education Coordinators Toward Vocational Student Organizations. Minneapolis, Minnesota: Delta Pi Epsilon, Phi Chapter, 1973. (ED 085 568)



- Mead, M. et al. Performance Content for Job Training: Processing Survey Data: Technical Appendices. Columbus: The Ohio State University, The National Center for Research in Vocational Education, 1977. (ED 146 373)
- Morgan, D. A Comparison Study of the Cooperative Distributive Education Student and Training Station Supervisor for Improved Placement Methods. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1977.
- Park, N. An Assessment of the Attitude of Distributive Education Students and Teacher-Coordination Toward Learning Activity Packages in Wisconsin and Indiana Secondary Schools. Ed.D. dissertation, Knoxville: The University of Tennessee, 1975.
- Parker, R. Evaluation of the Effectiveness of LAPS as Part of the Distributive Education Curriculum in Tennessee. Ed.D. dissertation, Knoxville: The University of Tennessee, 1979.
- Patton, J. An Appraisal of the Effectiveness of the Pilot Merit Awards Program in Distributive Education. Ed.D. dissertation, Knoxville: The University of Tennessee, 1971.
- Ramey, R. A Comparison of an Individualized System of Instruction and Conventional Group Instruction in Distributive Education. Ph.D. dissertation, Pittsburgh, Pennsylvania: University of Pittsburgh, 1976.
- Righthand, H. A Followup Study of Connecticut Distributive Education Graduates of the Classes of 1965-1968-1971. Hartford: Connecticut State Department of Education, Division of Vocational Education, 1977. (ED 141 369)
- Riley, C. "Evaluation of DECA Inservice Education." Forum. 28(April, 1974): 19-21.
- Roberson, R. Distributive Education Curriculum, Methods, and Materials Project. Whitewater: University of Wisconsin, 1979.
- Rossi, A. A Comparative Investigation of Attitudes and Opinions of Teacher-Coordination and Principals Regarding Selected Areas of the New Jersey Distributive Education Program. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1974.
- Rowe, K. Development of Selected Marketing Competencies Through Utilization of Two Methods of Teaching in the Secondary School. Ph.D. dissertation, E. Lansing: Michigan State University, 1969.

- Smith, D. A Study to Determine the Methods and Materials Used to Prepare Students for Competition in the 1979 Texas Distributive Education Clubs of America High School Division Career Development Conference. San Angelo, Texas: Angelo State University, Faculty Research Grant, 1979.
- Smith, G. Unit Achievement Tests in Distributive Education. Ph.D. dissertation, Chapel Hill: University of North Carolina, 1969.
- \_\_\_\_\_. An Experimental Study Utilizing A Prototype Instructional System for Teaching Interpersonal Relation Concepts in Salesmanship. Ed.D. dissertation, Moscow: University of Idaho, 1970.
- Snyder, R. Effectiveness of Employability-Skill Instruction on Achievement by Michigan Secondary Distributive Education Students. Ph.D. dissertation, E. Lansing: Michigan State University, 1978.
- Stapleton, C. A Computer-Assisted, Competency-Based Informational System Designed to Describe Student Distributive Occupational Proficiency Levels. Ed.D. dissertation, Minneapolis: University of Minnesota, 1977.
- Sternberg, A. A Study of Selected Values and Attitudes of New Jersey DE Students Who Are Members of DECA As Compared to New Jersey DE Students Who Are Not Members of DECA. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1976.
- Strate, J. A Comparative Benefit-Cost Study of One-Year Distributive Education and Two-Year Distributive Education Secondary Programs in Missouri. Ed.D. dissertation, Columbia: University of Missouri, 1974.
- \_\_\_\_\_. and Brorson, B. A Model Distributive Education Competency Based Learning Laboratory. Grand Forks: University of North Dakota, 1976. (ED 131 329)
- Stroh, T. Video Tape Feedback in the Development of Listening Skills by Industrial Salesmen. Ed.D. dissertation, New York, New York: Columbia University, 1968.
- Thrash, J. The Project Method in Distributive Education: Student Achievement in Selected Content Areas. Ed.D. dissertation, Stillwater: Oklahoma State University, 1970.
- Weber, L. An Evaluation Design for Field Testing Learning Activity Packages. Paper presented in New Orleans, Louisiana, 1972.



- \_\_\_\_\_. et al. The Evaluation of Learning Activity Packages Developed by the Interstate Distributive Education Curriculum Consortium. Paper presented at the annual conference of the AERA, Chicago, Illinois, 1974. (ED 098 261)
- \_\_\_\_\_. A Report on the Nature of the Use of Learning Activity Packages in Distributive Education Programs and the Determination of Change Orientation on Distributive Education Teachers. Paper presented at the AERA conference, San Francisco, California, 1976. (ED 126 347)
- Williams, T. Identification of Performance Tasks for Distributive Education Teacher-Coordination Who Utilize the IDECC System. Ph.D. dissertation, Columbus: The Ohio State University, 1977.
- \_\_\_\_\_. and Berns, R. Experimentation and Further Validation of the IDECC Competency Based Teaching Approach in Adult Education. Columbus: The Ohio State University, IDECC, Inc., 1978.
- \_\_\_\_\_. and Heath-Sipos, B. Experimentation and Further Validation of the IDECC Competency Based Teaching Approach in Postsecondary Education. Columbus: The Ohio State University, IDECC, Inc., 1978.
- Wisconsin State Board of Vocational, Technical, and Adult Education. An Assessment of Current and Projected Individualized Instruction in Business and Marketing Courses Provided by the Districts of the Wisconsin Vocational, Technical, and Adult Education System. Final Report. Madison: University of Wisconsin, 1971. (ED 066 586)

#### GUIDANCE AND COUNSELING

- Barger, B. A Study to Determine the Effectiveness of a Career Development Program in Distributive Education. Ed.D. dissertation, Knoxville: University of Tennessee, 1976.
- Braverman, B. The Implementation and Evaluation of a Formalized Recruitment Program for Distributive Education. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1972.
- Crawford, L. A Philosophy of Distributive Education. Blacksburg: Virginia Polytechnic Institute and State University, 1975.
- Husted, S. Perceptions of Secondary National Association of Distributive Education Teachers (NADET) Regarding Their Role in Guidance and Counseling. Ph.D. dissertation, E. Lansing: Michigan State University, 1977.

## TEACHER EDUCATION

- Allen, T. and Stoneman, J. Activities Performed by Teacher-  
Coordinators of Distributive Education Beyond the Regular  
Day. Boone, North Carolina: Appalachian State University,  
Staff Study, 1979.
- Ashmun, R. et al. Occupational Experience and Career Development  
Training for Distributive Educators and Vocational Counselors.  
Minneapolis: University of Minnesota, 1969. (ED 036 649)
- Berns, R. An Evaluation of the Undergraduate Distributive  
Education Program at VPI&SU. Blacksburg: Virginia Polytechnic  
Institute and State University, College of Education, 1979.
- \_\_\_\_\_ and Smith, C. A Competency-Based Inservice Training  
Program for Distributive Education Coordinators on Their Role  
as DECA Chapter Advisors. Blacksburg: Virginia Polytechnic  
Institute and State University, Virginia State Department of  
Education, 1979. (ED 171 996)
- Brownlee, R. Analysis of Opinions of Secondary Cooperative  
Distributive Education Teacher-Coordinators in Mississippi  
Toward Recommended Coordination Activities. Ed.D. dissertation,  
Blacksburg: Virginia Polytechnic Institute and State  
University, 1977.
- Buckner, L. and Gildan, K. Field Based Teacher Education and  
Curriculum Development for Pre-Vocational Distributive Education  
Teachers. Boca Raton: Florida Atlantic University, Department  
of Education, Division of Vocational, Technical, and Adult  
Education, 1975.
- Burrow, J. The Purposes of and Competencies Developed Through  
Occupational Experience for Distributive Education Teachers.  
Ph.D. dissertation, Lincoln: The University of Nebraska, 1976.
- Carter, K. An Evaluation of the Performance of Critical Tasks by  
Most Successful and Least Successful Cooperative Distributive  
Education Teachers. Ed.D. dissertation, Lexington: University  
of Kentucky, 1972.
- Charters, M. Empirical Determination of Effectiveness of a  
Competency-Based Program in Distributive Education. Syracuse,  
New York: Syracuse University, 1976. (ED 137 512)
- Clous, C. A Comparative Analysis of Training Sponsor Reactions  
to Selected Coordinator Tasks Performed by DE Teacher-Coordinators  
in Ohio. Ph.D. dissertation, Columbus: The Ohio State University,  
1976.

- Cooley, C. A Twenty-Year (1954-1974) Appraisal of the Master's Program in Business Education and Distributive Education at Northwestern State University of Louisiana. Ed.D. dissertation, Natchitoches: Northwestern State University of Louisiana, 1975.
- Cotrell, C. Model Curricula for Vocational and Technical Teacher Education: Report No. II. Columbus: The Ohio State University, The National Center for Research in Vocational Education, 1971. (ED 059 354)
- Crawford, L. A Competency Pattern Approach to Curriculum Construction in Distributive Teacher Education. Blacksburg: Virginia Polytechnic Institute and State University, 1967. (ED 032 383)
- \_\_\_\_\_. A Philosophy of Distributive Education. Blacksburg: Virginia Polytechnic Institute and State University, 1975.
- Eggland, S. The Development and Evaluation of a Directed Occupational Experience Program. Lincoln: University of Nebraska, 1978.
- \_\_\_\_\_. An Analysis of Student-Teacher Interaction in Distributive Education Classrooms. Ph.D. dissertation, Madison: The University of Wisconsin, 1971.
- Ferguson, E. Vocational Teaching in Diverse Cultural Settings. Columbus: The Ohio State University, The National Center for Research in Vocational Education, 1972. (ED 061 418)
- Foust, S. The Relationship Between Distributive Education Teacher Effectiveness and Selected Teacher Characteristics and the Competency Based Certification Examination. Ph.D. dissertation, Atlanta: Georgia State University, 1979.
- Gildan, K. Development of an Instructional Program to Prepare Distributive Education Teacher Coordinators to Teach the Educable Mentally Handicapped. Boca Raton: Florida Atlantic University, Florida State Department of Education, 1977.
- Graziano, L. The Identification and Validation of a List of Teaching Competencies Utilized by Distributive Education Teachers. Ed.D. dissertation, Detroit, Michigan: Wayne State University, 1974.
- Hansen, G. The Role of the Distributive Education Teacher Coordinator as Perceived by Iowa Distributive Education Teacher Coordinators and Their Principals. Ph.D. dissertation, College Station: Texas A & M University, 1975.

- Harrington, F. Development of a Self-Instructional Package on Cooperative Education Coordination Skills. Ph.D. dissertation, Columbus: The Ohio State University, 1970.
- Harris, E. Employer Preferences and Teacher-Coordinator Practices in Distributive Education. DeKalb: Northern Illinois University, 1971. (ED 049 392)
- Heath-Sipos, B. Attitudes of Distributive Education Teachers Toward Their Undergraduate Preparation to Conduct a Distributive Education Program. Ph.D. dissertation, Columbus: The Ohio State University, 1979.
- Hobbs, R. Selected Practices of Distributive Education Coordinators in Secondary Schools of the State of New York. Ph.D. dissertation, Bronx, New York: Fordham University, 1970.
- Irwin, P. Identifying Competencies of Postsecondary Mid-Management Instructor-Coordination by Comparing the Opinions and Perception of Selected Administrators and Mid-Management Instructor-Coordination in Texas. Ed.D. dissertation, Denton: North Texas State University, 1977.
- Isenburg, R. Professional Characteristics of Postsecondary Distributive Education Instructors in the Southeastern United States. Ed.D. dissertation, Knoxville: The University of Tennessee, 1977.
- Kinnaird, J. A Study of the Summer Agenda of Distributive Education Coordinators in Arkansas. Ed.D. dissertation, Fayetteville: University of Arkansas, 1977.
- Kirkley, J. Professional Development Competency Needs of South Carolina Distributive Education Teacher-Coordination. Ed.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1977.
- Kobe, J. An Analysis of Competencies Necessary for Adult Vocational Education Instructors Who Teach in Programs Reimbursed by the Minnesota State Department of Education. Ph.D. dissertation, Minneapolis: University of Minnesota, 1977.
- Kohns, D. An Analysis of Unconscious and Conscious Professional Development Needs of Minnesota Distributive Education Inservice Personnel. Ph.D. dissertation, Minneapolis: University of Minnesota, 1975.

- Ryan, D. A Study to Compare Coordination Practices Employed by Teacher Coordinators in Distributive Education in Oklahoma with Expected Coordination Practices. Ed.D. dissertation, Stillwater: Oklahoma State University, 1976.
- Searle, A. Certification Guidelines for Distributive Education as Perceived by State Supervisors and Teacher Educators of Distributive Education. Ed.D. dissertation, Knoxville: The University of Tennessee, 1977.
- Smith, D. Curricula Organizations and Content for the Preparation of Teacher-Coordiators of Cooperative Vocational Education Programs. Ph.D. dissertation, Minneapolis: University of Minnesota, 1973.
- Strate, J. and Brorson, B. A Model Distributive Education Competency Based Learning Laboratory. Grand Forks: University of North Dakota, 1976. (ED 131 329)
- Strydesky, R. The Validation of Evaluative Standards and Criteria for Distributive Teacher Education Through the Use of the Delphi Technique. Ph.D. dissertation, College Park: University of Maryland, 1977.
- Swenson, D. Personality Type as a Factor in Predicting Academic Achievement, Satisfaction, Success, and Group Membership of Business and Distributive Education Teacher Candidates. Ed.D. dissertation, Logan: Utah State University, 1976.
- Turner, J. An Exploratory Study of Predictive Relationships Between Personality Characteristics of Teachers of Disadvantaged Students and Principals' Ratings of Teacher Effectiveness. Ed.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1974.
- Vredenburg, D. Differences Between Effective and Ineffective Colorado and Wyoming Distributive Education Coordinators Based Upon Program, Coordination, and Curriculum. Ph.D. dissertation, Greeley: University of Northern Colorado, 1975.
- Walette, D. Criteria for Admission to Distributive Teacher Education Programs. Ed.D. dissertation, Minneapolis: University of Minnesota, 1974.
- Williams, T. Identification of Performance Tasks for Distributive Education Teacher-Coordiators Who Utilize the IDECC System. Ph.D. dissertation, Columbus: The Ohio State University, 1977.

Wray, R. The Perceived Roles and Program Content for Recruiting Prospective Distributive Education Teacher Coordinators in Region V. Ed.D. dissertation, Bloomington: Indiana University, 1970.

Zachrisson, R. Adult Distributive Education Instructor Behavior and Effectiveness as Perceived by Students. Ph.D. dissertation, Minneapolis: University of Minnesota, 1977.

#### ADMINISTRATION AND SUPERVISION

Amos, J. A Study of the Perceptions of Oklahoma Distributive Education Coordinators Regarding Functions of Local Advisory Committees. Ed.D. dissertation, Stillwater: Oklahoma State University, 1974.

Biddle, J. NASSDE Survey of State Supervision Structure for Distributive Education. Indianapolis, Indiana: National Association of State Supervisors of Distributive Education, 1972.

Crawford, L. A Philosophy of Distributive Education. Blacksburg: Virginia Polytechnic Institute and State University, 1975.

Daentzer, J. The Frequency and Significance of Tasks Performed by State Staff in Business and Distributive Education. Ph.D. dissertation, E. Lansing: Michigan State University, 1976.

Devitt, M. NASSDE 1978 Survey of State Supervision Structure for Distributive Education. Indianapolis, Indiana: National Association of State Supervisors of Distributive Education, 1978.

Smith, C. The Critical Tasks to be Performed by Department Heads of Secondary Distributive Education Programs in Virginia. Ed.D. dissertation, Blacksburg: Virginia Polytechnic Institute and State University, 1979.

#### EVALUATION

Adames, R. The Current Status and Future Directions of Distributive Education in New Hampshire. Ed.D. dissertation, Amherst: University of Massachusetts, 1975.



- . A Model for the Evaluation of the Distributive Education Program in Arizona. Tempe: Arizona State University, College of Business Administration, 1975.
- Allen, T. and Tugman, R. A Survey of DE Teachers and Students: Their Attitudes Toward Business and Their Knowledge About the American Economic System. Boone, North Carolina: Appalachian State University, College of Business, 1978.
- Banister, T. Evaluation of Facilities, Equipment, and Instructional Resources in Distributive Education Programs in Arkansas. Ed.D. dissertation, Fayetteville: University of Arkansas, 1969.
- Bennett, J. Disadvantaged and Non-Disadvantaged Urban High School Students' Perceptions of Work Within General Merchandise Retail Department Stores. New Brunswick, New Jersey: Rutgers - The State University, Graduate School of Education, 1971.
- Boyer, G. and Smith, G. Perceptions and Attitudes of Students, Business Personnel, and Private Citizens of Business, Government, Labor, and Other Selected Institutions in Utah. Provo, Utah: Brigham Young University, 1977. (ED 149 247)
- Bruce, J. The Status of Distributive Education Programs in the Public High Schools of Texas in 1967-68. Ed.D. dissertation, Waco, Texas: Baylor University, 1968.
- Brunner, W. Identification of System Inputs and Outputs for Minnesota Two-Year Community College Marketing Programs. Ph.D. dissertation, Minneapolis: University of Minnesota, 1977.
- Bryan, G. "Federal Aid - Expenditure or Investment?" American Vocational Journal. 45(January, 1970): 24-26.
- Buckner, L. and Gildan, K. A Followup Study of the 1971 and 1972 High School Distributive Education Students in Florida. Boca Raton: Florida Atlantic University, 1978.
- Cress, R. Evaluation of Service Station Attendant - Auto Care Project. Lansing, Michigan: Pine Lodge Halfway House, 1973. (ED 094 168)
- Cushman, R. The Relationship Between Selected Characteristics of Secondary Distributive Education Programs and Initial Job Employment or College Entrance. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1973.

- Daggett, W. Selected Distributive Education Teacher Characteristics as They Relate to the Retention of Graduates in the Field of Distribution in New York and Pennsylvania. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1974.
- Davis, E. An Investigation of Georgia's Distributive Education and Vocational Office Training Programs in Terms of the High School Principal's Perceptions. Ed.D. dissertation, Athens: University of Georgia, 1977.
- Domian, J. "Well-Trained DE Students Can Cope." American Vocational Journal. 49(March, 1974): 45-47.
- Dominick, F. The Relationship Between Distributive Education Co-Op Preparation at Detroit High Schools, Post High School Occupations, and Incidences of Promotion. Ed.D. dissertation, Detroit, Michigan: Wayne State University, 1973.
- Egan, R. and Loveless, A. The Distributive Education Curriculum as Evaluated by Businessmen and Distributive Education Students of Utah. Salt Lake City: Utah Research Coordinating Unit for Vocational and Technical Education, 1968. (ED 021 135)
- Faehnle, R. An Analysis of the Effect of High School Cooperative Distributive Education Upon Academic Achievement in Under-graduate College Marketing. Ph.D. dissertation, Bowling Green, Ohio: Bowling Green State University, 1976.
- Frunzi, G. A Study of the Relationship Between Management Understandings, Distributive Education Curriculum and Certain Personal Factors of DE Seniors in Selected Delaware High Schools. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1977.
- Gildan, K. A Study of Graduates of Distributive Education Middle Management Programs at Nine Community Colleges. Ed.D. dissertation, Boca Raton: Florida Atlantic University, 1975.
- Gleason, J. The Relationship of Sex and Selected Distributive Education Program Variables with Entry into Distributive Occupations After High School Graduation. Ph.D. dissertation, Columbus: The Ohio State University, 1979.
- Goodenough, L. An Evaluation of the Marketing Program in General College at the University of Minnesota. Ed.D. dissertation, Minneapolis: University of Minnesota, 1969.



- Gold, F. A Comparison of Selected Criteria for Distributive Education Program Operation with Practices in New York City Public High Schools. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1976.
- Gordon, J. An Assessment of New Jersey Distributive Education Programs as Perceived by Teacher/Coordinators and Principals. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1978.
- Grandfield, R. A Cost Analysis of Distributive Education Programs in Selected Delaware High Schools. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1972.
- Harris, R. and White, T. "Profiles of Small-City D.E. Program Graduates." DE Today. 8(Winter, 1975): 6-7.
- Hephner, T. A Study of Attitudinal Differences Between Cooperative Distributive Education Students and General or Academic Students of Similar Backgrounds Toward Retailing as a Career Goal. Ph.D. dissertation, Columbus: The Ohio State University, 1972.
- Hlebichuk, J. The Relationship of Selected Teacher-Coordinator, Program, and Student Variables to the Placement Status of the 1970 Secondary Cooperative Distributive Education Graduates in the State of Montana. Ed.D. dissertation, Bozeman: Montana State University, 1971.
- Hutt, R. Perceptions of Employers Regarding Cooperative Distributive Education Programs at the Secondary Level. Ph.D. dissertation, E. Lansing: Michigan State University, 1975.
- Iwler, I. A Study of the Status of Distributive Education in the Commonwealth of Pennsylvania, 1969-70. Ed.D. dissertation, Pittsburgh, Pennsylvania: University of Pittsburgh, 1970.
- Karp, F. A Survey of Distributive Education and Non-Distributive Education High School Seniors: Their Attitudes Toward Business and Their Knowledge About the American Economic System. Chicago, Illinois: Sears Merchandising Research, 1974.
- \_\_\_\_\_. A Survey of Distributive Education Teachers: Their Attitudes Toward Business and Their Knowledge About the American Economic System. Chicago, Illinois: Sears Merchandising Research, 1975.

- Lamuth, D. A Comparative Analysis of Distributive Education Programs in High Schools and Area Vocational-Technical Schools in the Commonwealth of Pennsylvania, 1973-74. Ph.D. dissertation, Pittsburgh, Pennsylvania: University of Pittsburgh, 1975.
- Little, M. Objectives and Evaluative Criteria for Distributive Education Programs at the Secondary Level in Michigan. Ph.D. dissertation, E. Lansing: Michigan State University, 1978.
- Lucas, S. et al. Assessment of Distributive and Office Education Programs: A Multivariate Analysis of Employees and Employer Satisfaction. Paper presented at the annual conference of the AERA, Washington, D.C., 1975. (ED 113 367)
- Miles, B. The Measurement of the Perceptions of Distributive Education as a Training Program Held by Distributive Education Students and Training Sponsors. Ph.D. dissertation, Columbus: The Ohio State University, 1971.
- Murphy, D. Determination of the Extent to Which Distributive Education Trained Work Experience Students Utilize Accepted Retail Sales Techniques in Comparison with Non-Distributive Education Trained Retail Salespeople. Ed.D. dissertation, Philadelphia, Pennsylvania: Temple University, 1975.
- Palmieri, D. The Relationship Between Distributive Education Co-op Preparation at Detroit High Schools, Post High School Occupations, and Incidences of Promotion. Ed.D. dissertation, Detroit, Michigan: Wayne State University, 1973.
- Patton, J. An Appraisal of the Effectiveness of the Pilot Merit Awards Program in Distributive Education. Ed.D. dissertation, Knoxville: University of Tennessee, 1971.
- Pride in Vocational Education and Guidance State Report 1972-73. Columbus: Ohio State Department of Education, Division of Vocational Education, 1973. (ED 113 578)
- Righthand, H. A Follow-Up Study of Connecticut Distributive Education Graduates of the Classes of 1965-1968-1971. Hartford: Connecticut State Department of Education, Division of Vocational Education. '77.